Cointegration and Causal Relationship between Gold Price and Exchange Rate in Myanmar (2011-2020)

ဒီသုတေသနစာတမ်းရဲ့ **Research Methodology (သုတေသန နည်းလမ်းများ)** အပိုင်းကို မြန်မာလို အသေးစိတ် ရှင်းပြပေးပါမယ်။

ဒီသုတေသနမှာ **ရွှေဈေး** နဲ့ **ငွေလဲနှုန်း** တို့ကြားက ရေရှည်ဆက်နွယ်မှုနဲ့ ဘယ်အရာက ဘယ်အရာကို ကြိုတင်ခန့်မှန်းမှုပေးနိုင်သလဲဆိုတဲ့ အကြောင်းရင်းခံဆက်စပ်မှုကို လေ့လာထားပါတယ်။

(၃.၁) ဒေတာ၏ အရင်းအမြစ် (Source of Data)

- လေ့လာချက် : ၂၀၁၁ ခုနှစ် ဇန်နဝါရီလမှ ၂၀၂၀ ဒီဇင်ဘာလအထိ (၁၀ နှစ်)
- **ဒေတာအမျိုးအစား** : လစဉ် ရွှေဈေးနှုန်းများနှင့် ကျပ်ငွေ/အမေရိကန်ဒေါ်လာ လဲနှုန်းများ
- **ဒေတာအရင်းအမြစ်** : ဗဟိုစာရင်းအင်းအဖွဲ့ (Central Statistical Organization - CSO) မှ ထုတ်ပြန်သော "Selected Monthly Economic Indicators"
- **လေ့လာမှုအရေအတွက်** : လပေါင်း ၁၂၀ (တစ်လ=၁ကြိမ်၊ ၁၀နှစ်=၁၂၀ကြိမ်)

(၃.၂) Unit Root Tests စမ်းသပ်ခြင်း

ဒေတာတွေကို စမ်းသပ်မှုမပြုလုပ်ခင် ၎င်းတို့သည် **Stationary** (တည်ငြိမ်မှုရှိသော) ဟုတ်မဟုတ် စစ်ဆေးရပါမယ်။

- **Stationary Data** ဆိုတာ ပျမ်းမျှတန်ဖိုး (mean)၊ ကွဲလွဲမှု(variance)တို့ ကာလအပိုင်းအခြားအလိုက် မပြောင်းလဲဘဲ တည်ငြိမ်နေခြင်းကို ဆိုလိုပါတယ်။
- **Non-Stationary Data** ဆိုရင် ရလဒ်များ မှားယွင်းစေနိုင်ပါတယ်။

စမ်းသပ်နည်း ၂ မျိုး သုံးထားသည် -

1. **Augmented Dickey-Fuller (ADF) Test**
2. **Phillips-Perron (PP) Test**

စမ်းသပ်မှုရလဒ် : ရွှေဈေးနှင့် ငွေလဲနှုန်း နှစ်ခုစလုံးသည် **Level (မူလပုံစံ)** တွင် Non-Stationary ဖြစ်နေပြီး၊ **First Difference (၁ ကြိမ်ခြားနားမှု)** တွင်မှ Stationary ဖြစ်ကြောင်း တွေ့ရသည်။

- **ဆိုလိုရင်း** : ဒေတာများကို ဆက်လက်ခွဲခြမ်းစိတ်ဖြာရန် First Difference ဖြင့် သုံးရမည်။

(၃.၃) အကောင်းဆုံး Lag Length ရွေးချယ်ခြင်း (Setting the Optimal Lag Length)

- **Lag** ဆိုတာ ယခင်ကာလများက တန်ဖိုးများကို လက်ရှိအခြေအနေအပေါ် သက်ရောက်မှုကို ဖော်ပြခြင်းဖြစ်သည်။
- **VAR Model** ကို သုံးပြီး Lag အမျိုးမျိုး (Lag 0 to Lag 8) အတွက် **AIC, SC, HQ** စသည့် စံသတ်မှတ်ချက်များဖြင့် စမ်းသပ်သည်။
- **ရလဒ်** : Lag 2 သည် အကောင်းဆုံးအရည်အချင်းပြည့်မီသော Lag Length ဖြစ်ကြောင်း တွေ့ရှိရသည်။

(၃.၄) Vector Autoregressive Model (VAR)

- VAR Model သည် စီးပွားရေးဆိုင်ရာ ကိန်းရှင်များကို ခန့်မှန်းရာတွင် သုံးသော မော်ဒယ်တစ်ခုဖြစ်သည်။
- ယခင်ကာလများက ရွှေစျေးနှင့် ငွေလဲနှုန်းတို့က လက်ရှိလက်ရှိ အခြေအနေကို ဘယ်လိုသက်ရောက်မှုရှိသလဲဆိုတာ လေ့လာနိုင်သည်။
- ဤမော်ဒယ်သည် ကိန်းရှင်တစ်ခုချင်းစီကို အခြားကိန်းရှင်များ၏ ယခင်တန်ဖိုးများဖြင့် ခန့်မှန်းပေးသည်။

(၃.၅) Johansen Cointegration Test

- ရွှေစျေးနှင့် ငွေလဲနှုန်းတို့ကြား **ရေရှည် ဆက်နွယ်မှု (Long-run Relationship)** ရှိ-မရှိ စစ်ဆေးခြင်းဖြစ်သည်။
- **စမ်းသပ်နည်း ၂ မျိုး** -
    1. **Trace Test**
    2. **Maximum Eigenvalue Test**
- **ရလဒ်** : ရွှေစျေးနှင့် ငွေလဲနှုန်းတို့ကြား **ရေရှည် ဆက်နွယ်မှု ရှိကြောင်း** တွေ့ရှိရသည်။

(၃.၆) Granger Causality Test

- ဘယ်ကိန်းရှင်က ဘယ်ကိန်းရှင်ကို **ကြိုတင်ခန့်မှန်းနိုင်စွမ်း** ရှိသလဲဆိုတာ စစ်ဆေးခြင်းဖြစ်သည်။
- **စမ်းသပ်မှုရလဒ်** :
    - **ရွှေဈေးက ငွေလဲနှုန်းကို Granger Cause လုပ်သည်** (p-value = 0.0600 < 10%)
    - **ငွေလဲနှုန်းက ရွှေဈေးကို Granger Cause မလုပ်ပါ** (p-value = 0.8402 > 5%)
- **နိဂုံး : ရွှေဈေးနှင့် ငွေလဲနှုန်းကြား တစ်ဘက်သတ် အကြောင်းရင်းခံဆက်စပ်မှု (Unidirectional Causality) ရှိသည်။**

အကျဉ်းချုပ်

ဤသုတေသနတွင် အောက်ပါအဆင့်များဖြင့် ရွှေဈေးနှင့် ငွေလဲနှုန်းဆက်စပ်မှုကို ခွဲခြမ်းစိတ်ဖြာထားသည် -

1. **ဒေတာစုဆောင်းခြင်း** (CSO မှ လစဉ်ဒေတာများ)
2. **တည်ငြိမ်မှုစစ်ဆေးခြင်း** (ADF & PP Tests)
3. **အကောင်းဆုံး Lag Length ရွေးချယ်ခြင်း** (VAR Model)
4. **ရေရှည်ဆက်နွယ်မှု ရှိ-မရှိစစ်ဆေးခြင်း** (Johansen Cointegration Test)
5. **အကြောင်းရင်းခံဆက်စပ်မှုစစ်ဆေးခြင်း** (Granger Causality Test)

တွေ့ရှိချက် : ရွှေဈေးနှင့် ငွေလဲနှုန်းတို့သည် ရေရှည်တွင် ဆက်နွယ်မှုရှိပြီး၊ **ရွှေဈေးကသာ ငွေလဲနှုန်းကို ကြိုတင်ခန့်မှန်းနိုင်စွမ်းရှိသည်။**

Lag Length အကြောင်း အသေးစိတ် ရှင်းလင်းချက်များ

အကောင်းဆုံး Lag Length ရွေးချယ်ခြင်း (Setting the Optimal Lag Length) အကြောင်းကို အသေးစိတ် ရှင်းပြပေးပါမယ်။

Lag Length ဆိုတာ ဘာလဲ ?

Lag ဆိုတာ **ယခင်ကာလများက တန်ဖိုးများ** ကို ဆိုလိုပါတယ်။

- **ဥပမာ** - ဒီနေ့ ရွှေဈေးကို မနေ့က ရွှေဈေး၊ တစ်ပတ်အကြာက ရွှေဈေးတွေက သက်ရောက်မှုရှိနိုင်ပါတယ်။
- **Lag Length** ဆိုတာ ဘယ်လောက်အတိတ်ကာလ (လ၊ ပတ်၊ ရက်) ကို ပြန်ကြည့်မလဲဆိုတဲ့ **အတိုင်းအတာ** ဖြစ်ပါတယ်။

ဘာကြောင့် အကောင်းဆုံး Lag Length ကို ရွေးချယ်ရတာလဲ ?

1. **Lag နည်းရင်** (Underfitting)
    - အရေးကြီးတဲ့ အတိတ်ကာလဆက်နွယ်မှုတွေကို လွဲမှားပစ်မိခြင်း
    - မော်ဒယ်က လက်တွေ့အခြေအနေကို ကောင်းကောင်းမကိုယ်စားပြုနိုင်ခြင်း
2. **Lag များရင်** (Overfitting)
    - မော်ဒယ်က အလကားအချက်တွေကိုပါ ထည့်သွင်းသွားခြင်း
    - ခန့်မှန်းမှုအား ကျဆင်းခြင်း
    - ဒေတာအမှားတွေ ပိုမိုပါဝင်လာခြင်း

အကောင်းဆုံး Lag Length ရွေးချယ်နည်းများ

ဒီသုတေသနမှာ **Vector Autoregressive (VAR) Model** ကိုသုံးပြီး အောက်ပါ **Information Criteria (အချက်အလက်စံသတ်မှတ်ချက်များ)** ဖြင့် ရွေးချယ်ထားပါတယ်။

အဓိက Criteria (စံသတ်မှတ်ချက်) ၃ မျိုး

စံသတ်မှတ်ချက်	**အတိုကောက်**	**ရှင်းလင်းချက်**

Akaike Information Criterion	AIC	မော်ဒယ်၏ ခန့်မှန်းမှုအားကောင်းမှုကို တိုင်းတာသည်
Schwarz Criterion	SC (or BIC)	မော်ဒယ်၏ ရိုးရှင်းမှုကို ပိုအလေးထားသည်
Hannan-Quinn Criterion	HQ	AIC နဲ့ SC ကြား အလယ်အလတ်

ရွေးချယ်နည်း : အနိမ့်ဆုံးတန်ဖိုး (Lowest Value) ရှိသော Lag Length ကို ရွေးချယ်ပါတယ်။

ဒီသုတေသနမှာ ဘယ်လိုရွေးချယ်ထားသလဲ ?

Table (4.5) Lag Length Selection ကို ကြည့်ရအောင်။

Lag	AIC	SC	HQ
0	40.30696	40.35550	40.32665
1	32.61263	**32.75826***	32.67172
2	**32.52363***	32.76635	**32.62211***
3	32.53151	32.87132	32.66938

ရလဒ်များ -

- **AIC** က Lag 2 ကို ရွေးသည် (အနိမ့်ဆုံးတန်ဖိုး - 32.52363)
- **SC** က Lag 1 ကို ရွေးသည် (အနိမ့်ဆုံးတန်ဖိုး - 32.75826)
- **HQ** က Lag 2 ကို ရွေးသည် (အနိမ့်ဆုံးတန်ဖိုး - 32.62211)

ဆုံးဖြတ်ချက် : **Lag 2** ကို ရွေးချယ်ထားသည်။

လက်တွေ့အသုံးချနည်း

Lag 2 ရွေးချယ်ခြင်း၏ အဓိပ္ပာယ် -

- **ဥပမာ** - ဇန်နဝါရီလရွှေဈေးကို ခန့်မှန်းရန် ဒီဇင်ဘာလနှင့် နိုဝင်ဘာလကရွှေဈေးများကို ကြည့်မည်။ Forecast for January **uses** last December and last November.

အရေးကြီးသော အချက်များ

1. **Lag Length ရွေးချယ်ခြင်းသည် အလွန်အရေးကြီးသည်** - မှားယွင်းသော Lag Length သည် ခန့်မှန်းမှုအားလုံးကို မှားယွင်းစေနိုင်သည်။
2. **Criteria များစွာကို တစ်ပြိုင်တည်းကြည့်ရှုခြင်း** - တစ်ခုတည်းကိုမကိုးကွယ်ဘဲ စံသတ်မှတ်ချက်အမျိုးမျိုးကို ချိန်ညှိကြည့်ရှုသည်။
3. **ဒေတာ၏ သဘောသဘာဝအပေါ် မူတည်ခြင်း** - ရွှေဈေးနှင့် ငွေလဲနှုန်းသည် ဈေးကွက်အခြေအနေအရ မကြာခဏပြောင်းလဲတတ်သောကြောင့် Lag 2 သည် သင့်တော်သည်။

အတိုချုပ် - Lag Length ရွေးချယ်ခြင်းသည် မော်ဒယ်၏ ထိရောက်မှုအတွက် အရေးကျသော အဆင့်ဖြစ်ပြီး၊ ဤသုတေသနတွင် Lag 2 ကို ရွေးချယ်ထားကြောင်း တွေ့ရပါတယ်။

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MASTER OF APPLIED STATISTICS PROGRAMME

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MYO NYI NYI ZIN

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MAS (3rd BATCH)

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This thesis is submitted to the Board of Examination as partial fulfillment of the requirement for the Degree of Master of Applied Statistics

Approved by the Board of Examiners

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ACCEPTANCE

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ABSTRACT

The main objective of the study is to analyze the cointegration and causal relationship between gold price and exchange rate in Myanmar. This study used monthly gold price and exchange rate data obtained from the Selected Monthly Economic Indicators; Central Statistical Organization of Myanmar for a period of 10 years from January 2011 to December 2020 with 120 observations. The techniques of time series econometrics such as unit root tests, Vector Autoregressive lag length of the model, Johansen cointegration test, and Granger causality test are used to analyze the cointegration and causal relationship between among the variables. The results of descriptive statistics revealed that the highest gold price and exchange rate occur in 2020 December and 2017 November. Additionally, the lowest gold price and exchange rate occur in 2011 June and August. Furthermore, the unit root test is used to check whether the exchange rate and gold price are stationary or not. Then, it observed that both of the data series are stationary at first difference. In addition to, the results of Johansen cointegration test discovered that the two variables have long run relationship. Therefore, in this study observed that the results of Granger causality test exhibit a unidirectional causal relationship between gold price and exchange rate in Myanmar. This study found that the changes in the gold price is impacted by the fluctuations of exchange rate in Myanmar.

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CONTENTS

		Page
ABSTRACT		**i**
ACKNOWLEDGEMENTS		**ii**
CONTENTS		**iii**
LIST OF TABLES		**v**
LIST OF FIGURES		**vi**
LIST OF ABBREVATIONS		**vii**
CHAPTER I	**INTRODUCTION**	**1**
1.1	Rationale of the Study	1
1.2	Objectives of the Study	3
1.3	Method of study	3
1.4	Scope and Limitations of the Study	4
1.5	Organization of the Study	4
CHAPTER II	**LITERATURE REVIEW**	**5**
2.1	History of Gold Price and Exchange Rate	5
2.2	Overview of Gold Markets in Myanmar	6
2.3	Volatility of Gold Market in Myanmar	9
2.4	Influencing Factors of Foreign Currencies	10
2.5	Exchange Rate Regime	13
2.6	Managerial Role of Central Bank in Myanmar	14
2.7	Exchange Rate and Policy Reforms in Myanmar	15
2.8	Review on Related Studies	17
CHAPTER III	**RESEARCH METHODOLOGY**	**22**
3.1	Source of Data	22
3.2	Unit Root Tests	22
3.3	Setting the Optimal Lag Length of the Model	25
3.4	Vector Autoregressive Model	26
3.5	Johansen Cointegration Test	28
3.6	Granger Causality Test	29
3.7	Procedure of Causality Testing	31

CHAPTER IV ANALYSIS OF THE CAUSALITY BETWEEN GOLD PRICE AND EXCHANGE RATE IN MYANMAR **32**

4.1 Descriptive Statistics of Gold Price and Exchange Rate in Myanmar 32

4.2 Testing the Stationary of Gold Price and Exchange Rate in Myanmar 36

4.3 Lag Length Selection of Gold Price and Exchange Rate in Myanmar 37

4.4 Johansen Cointegration Test of Gold Price and Exchange Rate in Myanmar 37

4.5 Causality Between Gold Price and Exchange Rate in Myanmar 39

CHAPTER V CONCLUSION **40**

5.1 Findings and Discussions 40

5.2 Suggestions and Recommendations 41

5.3 Needs for Further Study 41

REFERENCES

APPENDIX

LIST OF TABLES

Table No.	Title	Page
3.1	Critical Value for the Dicky-Fuller Test	24
4.1	Monthly Average Gold Price (Kyats per Ounce) in Myanmar	32
4.2	Monthly Average Exchange Rate (Kyats per US Dollar) in Myanmar	33
4.3	Descriptive Statistics of Gold Price and Exchange Rate in Myanmar	35
4.4	Testing the Stationary of Gold Price and Exchange Rate in Myanmar	36
4.5	Lag Length Selection of Gold Price and Exchange Rate in Myanmar	37
4.6	Results of Cointegration Test for Gold Price and Exchange Rate in Myanmar	38
4.7	Results of Causality Between Gold Price and Exchange Rate in Myanmar	39

LIST OF FIGURES

Figure No.	Title	Page
3.1	Procedure of Causality Testing	31
4.1	Gold Price (Kyats per Ounce) in Myanmar	33
4.2	Exchange Rate (Kyats per US Dollar) in Myanmar	34

LIST OF ABBREVATIONS

ADF	Augmented Dicky Fuller Test
AIC	Akaike's Information Criteria
ARCH	Autoregressive Hetroskedasticity
ASEAN	Association of South East Asian Nations
BIC	Bayesian Information Criterion
CBM	Central Bank of Myanmar
CLMV	Cambodia, Laos, Myanmar and Vietnam
COD	Cash on Delivery Service
CSO	Central Statistical Organization
FPE	Final Prediction Error Criteria
GFD	Gross Fiscal Deficit
HQ	Hannan Quinn Information Criteria
INR	International Exchange Rate
IMF	International Monetary Funds
IRP	Interest Parity
LM	Lagrange Multiplier
DW	Durbin-Watson
LR	Livelihood Ratio test statistics
MAB	Myanmar Agriculture Bank
MEB	Myanmar Economic Bank
MFTB	Myanmar Foreign Trade Bank
MGD	Myanmar Gold Development
MGEA	Myanmar Gold Entrepreneurs Association
MGMC	Myanmar Gold Market Centre
PP	Phillips Perron Test
SBMA	Singapore Bullion Market Association
SDR	Special Drawing Right
SIC	Schwarz Information Criteria
VAR	Vector Autoregression
VECM	Vector Error Correlation Model
YGEA	Yangon Gold Entrepreneurs Association
YSX	Yangon Stock Exchange

CHAPTER I
INTRODUCTION

Gold was one of the first metals excavated by humans. Gold as an asset is always considered as a 'safe haven' and as a medium of exchange. Both the Gold market and Foreign exchange market attracts the investors, as it provides better opportunities for their investment and other business activities. Even though it provides a safe haven to the investors and consumers, the returns and the risks from these markets are unpredictable. Since gold is superior to all other metals, both the developing and developed nations are frequently watching its price movements and its relationship with other financial instruments (Ranjusha, 2017).

1.1 Rationale of the Study

Gold is used as the manufacturing of precious jewelries. There are three types of gold in the modern jewelry market, yellow gold, white gold**,** and rose gold. Gold has a different colors depends on the metals used in the alloy mixture. Yellow gold is naturally occurring and is the purest form of the metal. 'Caratage' is the measurement of purity of gold alloyed with other metals. 24 carats are pure gold with no other metals. Lower caratages contain less gold; 18 carat gold contains 75 per cent gold and 25 per cent other metals, often copper or silver. The monetary system where it started in the manufacturing of coinage then countries used it for bills and gold certificates. In 19^{th} century which helped in their systems emphasizing the gold standard of money and then gold standard system during that period of time. Gold is the sacred precious yellow metal that had a great position during the ancient times and played an important role in the human society (Toraman et al., 2011).

Exchange rate is the value at which one of the currency can be converted into another form. On the other hand, it is the rate or value at which one currency can purchase another currency. The exchange rate plays an important role in the economics of money, banking and financial sector because it identifies the value

between two or more nation's trade for their commodities. The exchange rate is a very usefulness of the financial instruments. Countries have acceptable exchange rates often benefit from cheaper imports, but may find it more difficult to sell abroad. This is because global buyer and consumers require a far larger amount of currency to buy those goods. The exchange rate is the value by which two currencies can be traded for one another. There are three main types of exchange rate systems; fixed, floating, and administrative rate. The influencing factors for the fluctuations of the exchange rate such as the rate of interest, the performance of the economy, Balance of payment deficit or surplus, and the principles and practices of monetary policy (Boyce, 2022).

American dollar is an internationally accepted currency and most of the international transactions take place in dollar equivalent. The major reason behind the relationship of gold and exchange rate is that gold is used as a hedge against the adverse exchange value of dollar. As the dollar's exchange value decreases, it takes more dollars to buy gold, which increases the value of gold. The value of dollar can be at a potential risk of fluctuation through various factors like shifts in monetary policy, international trade, etc., but the value of yellow metal is largely determined by supply and demand, without interference from shifts in monetary and corporate policies (Nair, 2015).

In the world, the price of gold is influenced by the exchange rate furthermore, the fluctuations of exchange rate have a large impact on price of gold. Generally, when the exchange rate falls, the price of gold can go up; on the other hands the exchange rate rises, the price of gold may be fall. The fluctuations of the exchange rate presented by the foreign exchange market in dollar assets. The exchange rate rises, the investors are buying the dollar is influenced by the liquid assets to get revenue. Since the exchange rate was fallen, the investors are lack of reliability in dollar assets in covering of the purchasing gold in order to maintain their liquidity. In addition to, the decreasing of dollar rate, the exchange rate of Euro, Singapore, Japan, and many foreign currencies were rise, so that the price of gold is influencing by the other currencies relatively convenient in local gold market, which will be persuaded by the investors (Gulati, 1982).

Central Bank of Myanmar is responsible to determine the daily foreign exchange rate. It also sales a specified amount of foreign currency to Commercial Bank and permissible money changers, which constraints the amount of foreign exchange available for trade in market. Major global currencies are such as pound

sterling, US dollar, Euro dollar may be obliged and compliment and thus impact of gold price. The US dollar is the most frequently transformed liquid assets all over the world. Organization are used to settle foreign exchange transactions including exports and imports of products and services, for foreign direct investment. Additionally, the US dollar is used as the standard of currency in commodity market and therefore it has a direct effect on price of commodity. In 1785, US dollar was adoption of the money in American United States. Actually 1.2 trillion of dollars traded in capital markets in every day. The US dollar is very useful global currencies in all over world. Myanmar is known as 77^{th} largest foreign reserve funds holder in the world. (US dollar of 8463 Millions). The foreign exchange reserves by the top 10 countries are: Japan, India, Russia, China, Switzerland, Hong Kong, South Korea, Taiwan, Saudi Arabia, and Brazil (Swe, 2019).

Both gold price and exchange rate are not only supportive of economy development, but also plays a vital role in a trading sector and in payments between counties. Hence, the cause of fluctuation in exchange rate is also effects the changes of gold price in Myanmar for decision making in economic sector development in Nation's. For this reason, Granger causality test was used to analyzed the exchange rate and gold price in Myanmar.

1.2 Objectives of the Study

The objectives of this study are;

- To describe the situations of exchange rate and gold price in Myanmar.
- To analyze the causal relationship between exchange rate and gold price in Myanmar.

1.3 Method of Study

Firstly, descriptive statistics was used to describe the situation of exchange and gold price in Myanmar. Secondly, unit root test was carried out to examine the data is stationary or non-stationary and the optimal lag length was chosen by using vector autoregressive (VAR) lag selection. Johansen cointegration test was used to find out whether there is cointegration or not. Finally, Granger causality test was used to explore the changes of gold price are also effects the fluctuations of exchange rate in Myanmar.

1.4 Scope and Limitations of the Study

The secondary source of data was used for this study. Data of exchange rates above (K1,400) and gold price (K1313,375) per tical (1 tical is 0.578 ounce or 0.016 kilogram) in Myanmar for 10 years has been collected in Selected Monthly Economic Indicator for January 2011 to December 2020 published by the Central Statistical Organization (CSO) in Myanmar.

1.5 Organization of the Study

This study is organized into the five chapters. Chapter I is introduction section consisting rationale of the study, objectives of the study, method of study, scope and limitations of the study and organization of the study. Chapter II contains the theoretical background and reviews of the related studies of exchange rate and gold price in Myanmar. Chapter III presents the research methodology. Chapter IV concerns with the results and findings. Conclusion, findings and discussions, suggestions and recommendations and needs for further studies are presented in Chapter V.

CHAPTER II
LITERATURE REVIEW

Gold has been an important commodity in the world economy for a long time, the effect of this policy on monetary economics is significant. The gold standard was used throughout the nation's borders. Gold still plays an important role in international affairs, because it serves as a policy indicator in illustrating various monetary and fiscal policy. Gold production and the price of gold have a significant impact on the commodity market because it is an important value chain, contributing to the mining industry and general production and consumption. The US dollar is one of the most global currency in the global financial market, it have any variations in the monetary policy and significant impacts on the global financial market. Thus, many researchers conducted different studies to know the cointegrating relationship between gold price and exchange rate. Following are the reviews of some previous studies about gold price and exchange rate review of methods are presented.

2.1 History of Gold Price and Exchange Rate

According to the Nair et al., 2015, after the First World War, nations attempted to revive the gold standard for international exchange rates, but the system soon collapsed with the arrival of the Great Depression of the 1930s. Some economists were of the view that the strict obedience to the gold standard had prevented monetary authorities all over the world from increasing the money supply to match the growing demand for money which could have been enough to revive economic activity. After the end of the Second World War, representatives of most of the world's leading nations met at Bretton Woods, New Hampshire, in 1944 to create a new international monetary system. United States had emerged as politically strong nation on the winner side after the war. It was the world leader in terms of manufacture capacity and accounted for over half of the world's capacity. The nation also held most of the world's gold at that time.

Therefore, the leaders decided to tie world currencies to the dollar, which, in turn, they agreed should be convertible into gold at a fixed exchange rate of $35 per ounce. This was known as the Bretton Woods System. The system required the central banks of countries other than that of United States to maintain a fixed exchange rate between their currencies and the dollar. The US Dollar could be internationally exchanged for gold. The central banks had to accomplish this task by intervening in foreign exchange markets. If the exchange value of a country's currency was too high relative to the dollar, its central bank would sell its currency in exchange for dollars, which will make the value of its currency to sink down. Conversely, if the value of a country's money was too low, the country would buy its own currency, thereby driving up the exchange value.

The Bretton Woods system successfully lasted until 1971 but the problem arrived when the high rate of inflation and growing trade deficit of USA were undermining the value of the dollar. During the same period, Germany and Japan had favorable balance of payments because they had high volumes of exports. The United States asked the two nations to appreciate their currencies. But the two nations were reluctant to do so as appreciation of their currency would hurt their exports as it will increase the prices of their goods making them internationally incompetent. With the passage of time, the situation in USA went from bad to worse and worst.

According to the United Nations, floating exchange rate system for USD against other currencies and abandoned the fixed exchange rate system. The exchange value of dollar promptly fell. This alarmed the world leaders who maintained high reserves of Dollar thinking it to be exchangeable for gold. Many countries sought to resuscitate the old Bretton Woods system and proposed the Smithsonian Agreement in 1971 which was similar to Bretton Woods system, but the effort failed. By 1973, various nations, including USA adopted the floating exchange rate system for their currencies. Hence, now the dollar was no more equivalents to gold at a fixed rate but this psychology still persists (Nair et al., 2015).

2.2 Overview of Gold Markets in Myanmar

Many Asian countries, gold is a popular investment and used as a store of wealth in Myanmar, particularly as a slowdown in other areas of the economy, including the property market, are pushing local investors to invest in gold. The gold market in Myanmar is very liquid, but it is illegal to export Myanmar gold. supply

chain in Myanmar comprises wholesalers, providers, jewellers, retailers, miners and refiners, including four major refiners and 25 small refiners, with wholesale markets located in Yangon and Mandalay. Three associations support the supply chain: Myanmar Gold Development Public Company, Myanmar Gold Entrepreneurs Association, and Yangon Gems & Jewellery Entrepreneurs Association. However, the infrastructure for gold trading is still not developed. Many activities, including settlement procedures, are currently not regulated. Refining levels are also below international standards (the quality gold is typically 99%, not “Four Nine”). As standardization is not strict, the purity of gold varies depending on source. The distribution of gold demand is as follows store of wealth: 55%; jewellery: 40%; industrial: 5%. The wholesale market in Yangon, located at 42 Shwe Bhone Thar Street, managed by the Myanmar Gold Entrepreneurs Association (SBMA, 2017).

According to the SBMA (2017), all market players (floor traders) are members of the Myanmar Gold Entrepreneurs Association. The association has about 300 members, who pay a membership fee of 500,000 kyats (US$382) per year. All trades are done by open outcry on the floor. There is no booth, and a pit only on the floor. Traders use mobile phones to contact external parties and as there is no proper clearing system, trades are not recorded. As such, a lot of the trader work on the basis of trust. Settlement takes place physically in another location by COD. Myanmar has an independent gold market, so gold prices are not necessarily determined by international prices. However, trading prices closely reflect international market prices, and it appears that traders refer to international spot prices at the time of opening as a benchmark, converting it to local units and currency (SBMA, 2017).

2.2.1 The Role of Gold Bar Retail Markets and Investment

Retail gold bars are traded in Myanmar using local scales: Kattha (Ticals) = 16.3293 g, Petha = 1.02058 g, Yway lay = 136.078 mg, and the local currency (kyat). Transactions may not be entirely transparent, and prices may differ among shops and in different regions. Three brands are prominent in the market, namely, Academy, Aung Thamradi and Ba Than. The Myanmar government encourages foreign and local investors to invest in the mining sector, subject to 5% royalty upfront and a production sharing of about 30% of net output. Investors can enter a mining sector with a foreign direct investment or through a joint investment with a local company. Besides this, the Myanmar government also encourages the establishment of refinery

plants as well as smelters with the latest technology. The size of the gold mining market is anybody's guess. There are currently 5 to 6 blocks of large-scale mining rights granted to a few big companies at Waphyutaung Area, Yamethin Township, Mandalay Region. Collectively, they could be around 5-10 tonnes of output annually. There are about 472 small-scale mining companies registered with the Mining Ministry (SBMA, 2017).

2.2.2 The Role of Myanmar Gold Development (MGD)

Myanmar Gold Development (MGD), the commercial arm of the Myanmar Gold Entrepreneurs Association (MGEA), was set up on 27 June 2012, with an authorized capital of 1 trillion kyats (US$1.1 billion). Shares will be sold for 100,000 kyats each and investors who buy at least 250 shares are eligible to sit on its board of directors. MGD currently has 12 shareholders MGD was set up to prepare for new foreign direct investment by bringing together small and medium-sized enterprises into a public company. MGD would also increase public investment opportunities, boost the economy and increase the number of opportunities for the mining industry to work with foreign companies to improve its capabilities (SBMA, 2017).

MGD has been active in trying to build a modern gold trading mechanism for the Myanmar gold market that would service the gold mining sector and help the central government to account for local gold production with a proper export channel. In 2017, after a long period of overseas market visits and consultation, MGEA advised the government to create a central trading platform. Known as the Myanmar Gold Market Centre (MGMC), the platform aims to improve the quality of gold products and bring pricing in line with international standards (SBMA, 2017).

2.2.3 The Role of Myanmar Gold Entrepreneurs Association (MGEA)

While the MGEA will restrict trading to local investors initially, it has publicly announced an interest in bringing in foreign investors at a later stage. Physical gold transactions in Mandalay and Yangon are currently not tightly regulated and are self-regulated by the two respective associations, with no strict standard on locally produced gold. Advancements are set to be made in various areas to raise the level and standards of trade. The intention is to put official trademarks on gold bars, and MGEA is pressing the government to regulate taxes on gold, all of which will aid the development of the initiative of creating a vibrant domestic gold market.The

numerous hurdles to the development of the gold market mostly mirror those faced by the Yangon Stock Exchange, such as raising accounting standards, following international best practices, recruiting experienced technical staff and local traders, as well as recruiting enough market participants, but these are steps in the right direction. The current infrastructure and supply chain for gold are for domestic trading only as the import and export of gold are currently prohibited under the laws of Myanmar (SBMA, 2017).

2.3 Volatility of Gold Market in Myanmar

Yangon Region Gold Entrepreneurs Association (YGEA) urged its members to regulate trade in order to deal with market volatility. Last 28 August, YGEA made five decisions, including the strategic trade control, at the monthly meeting. At present, along with the Kyat depreciation and the gold price gain in the international market, the precious pure gold metal stands at K1,688,000 per tical (0.578 ounce, or 0.016 kilogram) (Global New Light of Myanmar, 2021).

According to the Global New Light of Myanmar (2021), the global gold price stood at only US$1,815 per ounce at present, while the US dollar exchange rate is worth above K1,700. Despite the domestic gold price staying in the upward trend, the market is pretty sluggish, according to the YGEA. Earlier, about 50 viss (a viss equals 1.6 kg) were daily traded. At present, the market sees sales of only 5-10 viss. On 12 May, the gold hit an all-time high of K1,709,000 per tical in history.

In January 2021, the gold price was ranged between the minimum of K1,316,000 per tical (28 January) and the maximum of K1,336,000 per tical (6 January). It reached an all-time high of K1,410,000 per tical on 3 February and hit the minimum of K1,340,000 per tical on 2 February. In March, the rate fluctuated between the highest of K1,391,000 (25 March) and the lowest of K1,302,000 (4 March). The price was registered the highest of K1,455,000 (30 April) and the lowest of K1,389,000 (1 April). The price reached and all time highest of K1,709,000 (12 May) and the lowest of K1,447,000 in May. The price moved in the maximum of K1,575,500 (11 June) and the minimum of K1,543,000 (19 June).

Last month, it fluctuated between K1,562,300 (26 Jul) and K1,587,000 (K1,587,000), the gold traders said. According to gold traders, the local gold reached the lowest level of K1,310,500 (2 September) and the highest level of K1,314,000 (1 September). In October, the rate ranged between K1,307,800 (30 October) and

K1,316,500 (21 October). The rate fluctuated between the highest of K1,317,000 (9 November) and the lowest of K1,270,000 (30 November). In December, the pure yellow metal priced moved in the range of 1,280,000 (1 December) and 1,332,000 (28 December). With global gold prices on the uptick, the domestic price hit fresh highs in 2019, reaching K1,000,000 per tical between 17 January and 21 February, crossing K1,100,000 (22 June to 5 August), climbing to over 1,200,000 (7 August-4 September), and then reaching a record high of K1,300,000 on 5 September 2019.

2.4 Influencing Factors of Foreign Currencies

The foreign exchange market is a form of exchange for the global decentralized trading of international currencies. Financial centers around the world function as anchors of trading between a wide range of different types of buyers and sellers around the clock, with the exception of weekends. The foreign exchange market determines the relative values of different currencies. The foreign exchange market assists international trade and investment by enabling currency conversion. It also supports direct speculation in the value of currencies, and the carry trade, speculation based on the interest rate differential between two countries. In a typical foreign exchange transaction, a party purchases a quantity of one currency by paying a quantity of another currency. The market in which participants are able to buy, sell, exchange and speculate on currencies. Foreign exchange markets are made up of banks, commercial companies, central banks, investment management firms, hedge funds, and retail forex brokers and investors. The forex market is considered to be the largest financial market in the world. Because the currency markets are large and liquid, they are believed to be the most efficient financial markets. It is important to realize that the foreign exchange market is not a single exchange, but is constructed of a global network of computers that connects participants from all parts of the world. The foreign exchange market is the most liquid financial market in the world. Traders include large banks, central banks, institutional investors, currency speculators, corporations, governments, other financial institutions, and retail investors (Singh et al., 2013).

2.4.1 Reserves of Foreign Currency

Traders are the reserves of foreign currency held with the central bank of domestic economy. These are accumulated by continual surpluses in the overall

balance of payments accounts. This accumulation causes an increase in the supply of foreign exchange in the market and shifts the supply curve of foreign exchange to the right (AJBM, 2017).

2.4.2 Interest Yield Differentials

The relation of exchange rate with short-term and long-term interest yield differentials and is complex (Suthar, 2008). Broadly there are two views regarding this relationship between the interest rate and exchange rate. According to one view uncovered interest parity (IRP) theory which postulate that domestic interest rate is the sum of world interest rate and expected depreciation of home currency serve as basis for exchange rate determination. In other words, the interest rate differential between domestic and world interest rate is equal to the expected change in the domestic exchange rate. Therefore, a higher interest differential resulting from high domestic interest rate would attract capital inflows and cause the appreciation of domestic currency against foreign currency. However, there is an alternative view also, monetarists believe that higher interest rate reduces the demand for money (as the cost of borrowing will rise for businesses and household) which leads to depreciation of currency due to high domestic inflation (AJBM, 2017).

A large real appreciation of a country's currency following excessive capital inflows will discourage the export which lead to considerable current account deficit. Persistent current account deterioration increase vulnerability to crisis. In order to avoid this domino effect, emerging market economies have adopted several different policies such as sterilized foreign exchange intervention (such sterilization eliminate the effect of foreign exchange intervention on domestic money supply), modest capital controls and fiscal tightening (Jain, 2012).

2.4.3 Inflation Differential

There is a direct relationship of inflation differential with domestic exchange rate. In other words, a higher domestic inflation relative to that of other nations results into depreciation of domestic currency. This is so because an increase in domestic inflation as compared to world inflation would increase the domestic demand for foreign commodities and lowers the foreigndem and for domestic commodities, as more and more domestic consumer will shift toward foreign goods, supply of domestic currency in foreign exchange market will increase when these consumers

will sell domestic currency for foreign currency. This process would require depreciation of domestic currency to maintain the exchange rate as per the purchasing power theory. By same token, a decrease in domestic inflation as compared to world inflation causes appreciation of domestic currency. Therefore, the higher the inflation differential between domestic and foreign countries, the higher will be the depreciation of domestic currency and vice versa. This theory is called the Purchasing Power Parity (Jain, 2012).

2.4.4 Liquidity

The liquidity in an economy increases with growth of broad money and foreign exchange reserves. Theoretically increase in liquidity is likely to be followed by depreciation of domestic currency. To understand this, increased liquidity causes inflationary pressure when the output is not growing at proportionate rate, this inflationary pressure will hamper the competitiveness of export and result into depreciation of domestic currency (Ramifications of this will be similar to as discussed for high inflation differential). However, it is interesting to note that, an increase in the foreign exchange reserves also implies an increase in the supply of foreign currency, which often results in appreciation of the domestic currency. This is investigated by introducing the growth rate of broad money and the growth rate of foreign exchange reserves as explanatory variables in the model (Suthar, 2008).

2.4.5 Gross Fiscal Deficit

Gross fiscal deficit is one of the ‘deficit indicators’. The other deficit indicators are Revenue Deficit denotes the difference between revenue receipts and revenue expenditure. The conventional deficit (budgetary deficit) is the difference between all receipts and expenditure, both revenue and capital. The gross fiscal deficit (GFD) is the excess of total expenditure including loans net of recovery over revenue receipts (including external grants) and non-debt capital receipts. Government opt for various means to finance the gross fiscal deficit; external finance, market borrowing, other borrowings are some of them. A fiscal deficit is regarded by some as a positive economic event. For example, economist John Maynard Keynes believed that deficits help countries climb out of economic recession. On the other hand, fiscal conservatives feel that governments should avoid deficits in favor of a balanced budget policy. Since gross fiscal deficit is mainly caused by excess of government

expenditure over government revenues, which means government is spending more and leading to increase in money supply in economy hence finally resulting into inflation which is a cause of currency depreciation. So, we can say that although gross fiscal deficit does not cause a direct effect on exchange rate but it does affect exchange rate by increasing the inflation (Jain, 2012).

2.5 Exchange Rate Regimes

According to the finance and development 2018, exchange rate regimes are typically divided into three broad categories. At one end of the spectrum are hard exchange rate pegs. These entail either the legally mandated use of another country's currency (also known as full dollarization) or a legal mandate that requires the central bank to keep foreign assets at least equal to local currency in circulation and bank reserves (also known as a currency board). Panama, which has long used the U.S. dollar, is an example of full dollarization, and Hong Kong SAR operates a currency board. Hard pegs usually go hand in hand with sound fiscal and structural policies and low inflation. They tend to remain in place for a long time, thus providing a higher degree of certainty for pricing international transactions. However, the central bank in a country with a hard exchange rate peg has no independent monetary policy because it has no exchange rate to adjust and its interest rates are tied to those of the anchor currency country.

Depending on differences in inflation rates across countries. Costa Rica, Hungary, and China are examples of this type of peg. Although soft pegs maintain a firm "nominal anchor" (that is, a nominal price or quantity that serves as a target for monetary policy) to settle inflation expectations, they allow for a limited degree of monetary policy flexibility to deal with shocks. However, soft pegs can be vulnerable to financial crises which can lead to a large devaluation or even abandonment of the peg and this type of regime tends not to be long lasting.

At the other end of the spectrum are floating exchange rate regimes. As the name implies, the floating exchange rate is mainly market determined. In countries that allow their exchange rates to float, the central banks intervene (through purchases or sales of foreign currency in exchange for local currency) mostly to limit short-term exchange rate fluctuations. However, in a few countries (for example, New Zealand, Sweden, Iceland, the United States, and those in the euro area), the central banks almost never intervene to manage the exchange rates. Floating regimes offer countries

the advantage of maintaining an independent monetary policy. In such countries, the foreign exchange and other financial markets must be deep enough to absorb shocks without large exchange rate changes. Also, financial instruments must be available to hedge the risks posed by a fluctuating exchange rate. Almost all advanced economies have floating regimes, as do most large emerging market countries.

2.6 Managerial Role of Central Bank in Myanmar

According to the CACJ (2022), the Union Bank of Burma was established on 3rd April 1948 by the Act of Union Bank of Burma 1947. In 1st July 1952, the Union Bank of Burma Act was enacted. The Union Bank of Burma was established with an authorized capital of 40 million Kyats and a paid-up capital of 10 million Kyats by the Government. The People's Bank of the Union of Burma Act was enacted in 1967 and a monolithic bank known as the People's Bank of the Union of Burma was established in 1969 with the initial paid-up capital of 200 million Kyats that was fully contributed by the State. After Myanmar adopted the socialist economic system in 1962, all banks were nationalized. Under the People's Bank of the Union of Burma Act 1967, a monolithic bank was formed. After the administrative system was reformed in 1972, the Union Bank of Burma Law of 1975 was promulgated and the banking system was recognized. The name of the People's Bank of Union Bank of Burma was changed to the Union of Burma Bank. Consequently, four banks, namely the Union of Burma Bank, Myanmar Economic Bank(MEB), Myanmar Foreign Trade Bank (MFTB) and Myanmar Agriculture Bank (MAB) emerged. In accordance with the 1975 Bank Law, the initial paid-up capital of the Union Bank of Burma was 200 million Kyats that was fully contributed by the State.

After 1988, the Myanmar economic system has been transformed from the planned economic system to market oriented system. To develop the financial system which is in line with the market oriented by the Government, and to promote the efficiency of financial activities, the Central Bank of Myanmar Law was enacted in 2nd July 1990. The Central Bank of Myanmar was established with the paid-up capital of 500 million Kyats and of which 200 million Kyats were fully paid-up by the State. According to the new government, which was formed on March 30, 2011, the Central Bank of Myanmar was to independently lay down the policies. The Central Bank of Myanmar needs to enact monetary policy independently to control price stability in the domestic market and to preserve the internal and external value of the

Myanmar currency, the kyat. According to the new law of the Central Bank (Draft), the Central Bank of Myanmar will be set up with paid up capital of 300 Billion kyats and of which 100 billion kyats will be fully paid up by the State (CACJ, 2022).

The aim of the Central Bank is to control the price stabilities in the domestic market and to preserve the internal and external value of the Myanmar Currency, the kyat. In accordance with its aim, the Central Bank also endeavors to attain such objectives so as to promote efficient payments mechanisms, and the liquidity, solvency, and proper functioning of a soundly based financial system and to foster monetary, credit and financial conditions conductive to an orderly, balanced, and sustained economic development (CACJ, 2022).

The main responsibilities of the Central Bank of Myanmar are;

(a) to act as to role issuer of domestic currency and as a banker to the Government;
(b) to act as an adviser to the Government in respect of economic matters;
(c) to inspect and supervise the financial institutions;
(d) to act as a banker for the financial institutions;
(e) to manage the international reserves of the State and to perform the transactions resulting from the participation of the State in intergovernmental organization and to undertake all the responsibilities in the name of the Government in dealing with the aforesaid organizations on behalf of the Government (CACJ, 2022).

2.7 Exchange Rate and Policy Reforms in Myanmar

According to the JETRO (2013), Until the April 2012, Myanmar maintained a multiple exchange rate regime. Since 1977, the official exchange rate was pegged to the special drawing right (SDR) of the International Monetary Fund (IMF) and had been fixed at 8.50847 kyat per SDR for more than three decades. Because the official exchange rate was applied only for public sector transactions, the parallel market developed in the private sector. Thus, the foreign exchange market was segmented between the public and private sectors. This parallel market exchange rate fluctuated notably in real terms. For the four ASEAN latecomers (Cambodia, Lao PRD, Myanmar, and Vietnam) and Singapore and Thailand, trends in the real exchange rates of the local currencies vis-à-vis the US dollar are summarized in Figure 1. Here, the real exchange rates are defined in local currency terms. A rise in the real exchange

rate signifies that the home currency depreciates against the US dollar. The figure shows that fluctuations in Myanmar's real exchange rate are volatile compared to those in the other countries. One reason for the pronounced real exchange rate fluctuations could be the absence of central bank intervention in the parallel foreign exchange market.

Furthermore, the appreciation of the real exchange rate since 2007 has been pronounced in Myanmar. While all currencies in this figure demonstrate appreciation of trends against the US dollar, the extent of appreciation is the sharpest in the Myanmar kyat. This indicates that the Myanmar kyat appreciated against other ASEAN currencies as well. And then, the new government, inaugurated in March 2011, abolished the fixed exchange rate and announced the move to a managed float regime. This reform aims to unify the segmented foreign exchange market, which in turn will allow the central bank to intervene in the market. Consequently, questions arise as to whether exchange rate policies will be effective in stabilizing the real exchange rate and to what extent complementary sterilization of the money supply will be necessary to sustain the effect of foreign exchange market intervention (JETRO, 2013).

For Myanmar, exchange rate policies consist of foreign exchange market interventions and complementary sterilization. The central bank can produce nominal exchange rate depreciation by interventions to purchase foreign exchange from the market. However, such foreign exchange market interventions have a side effect of monetary expansion which drives inflation. As inflation cancels out nominal exchange rate depreciation, it negates the effects of foreign exchange market interventions on the real exchange rate. Sterilization is to absorb the excess local currency released in interventions by open market operations. The faster prices adjust to changes in money supply, the more crucial the complementary sterilization is for effective exchange rate policies (JETRO, 2013).

2.8 Review on Related Studies

Gold is always considered as a “Safe Haven” for investments especially at the time of economic and financial stress. A ‘safe haven’ can broadly be defined as an asset that protects investors’ wealth against financial turmoil. Therefore, an asset with a stable real value or, at least a stable nominal value is an uncontroversial safe haven, as it allows its holder to resell it without loss at any time (Raymond, 2010).

During the last decade, volatility of gold prices has been higher than that of sovereign bond markets but lower than riskier assets like equities and other commodities. There is some empirical evidence that gold could be a hedge even against stocks, though only in the short run (Lucey, 2010).

Arezki et al. (2012) used the Johansen cointegration and Granger causality test to find out the causality between the gold price and exchange rate in case of prior and post capital account liberalization in South Africa. The findings of this study indicated that the direction of causality was from exchange rate of Rand to gold price in pre libralization phase. However, the flow of causality has revered in post libralization phase. The main findings found that prior to capital account liberalization the causality runs from South African Rand to gold price volatility but the causality runs the other way around for the post-liberalization period. These findings suggest that gold price volatility plays a key role in explaining both the excessive exchange rate volatility and current disproportionate share of speculative short-run inflows that South Africa has been coping with since the opening up of its capital account.

Samanta and Zadeh (2012) investigated the relationship between oil price, gold price, exchange rate and stock price in USA. Johansen cointegration and Granger causality test are used to analyze the variables of this study. The results found clear that long-run cointegrating relationship between the variables with a coefficient of -1.35, and changes of gold price are also effect the fluctuating the exchange rate.

Patel (2013) described the relationship between inflation rate, exchange rate and gold price in India by using monthly data from January 1991 to September 2012. Johansen cointegration test was used to analyze in this study indicated that there exists a long run cointegrating relationship between the variables of inflation rate, exchange rate and gold price in India (1991-2012).

Bhunia (2013) stated that the long term association between crude oil prices, gold prices, US Dollar exchange rate and stock price indices in India. This study also used Johansen co-integration and granger causality test and indicated that there exists

a long term association between the variables under study. The study further stated that there is a bi directional relationship among the variable under study. However, the study has not segregated the duration of the global financial crisis and included the data since January 1991 to October 2012 at a streach.

Bilal (2013) proposed that the long-run relationship between gold price, Karachi Stock Exchange (KSE) stock index and Bombay Stock Exchange (BSE) stock index. The statistical techniques used for this study includes Unit Root Augmented Dickey Fuller test, Phillips-Perron, Johnson Co-integration and Granger's Causality tests to measure the long-run relationship between gold prices, KSE and BSE using monthly data from 1st July 2005 to 30th June 2011. Findings of the cointegration test indicated that no long-run relationship exist between monthly average gold prices and KSE stock index; whereas, a significant long-run relationship is proved between BSE stock index and average gold price. Results of Granger causality test demonstrated that no causal relationship between average gold price, KSE and BSE stock indices.

Wang and Chueh (2013) studied the dynamic relationship between the interest rate, crude oil price, the US dollar, and gold prices. In this study shows that in the short term both gold and crude oil prices positively influence each other. Interest rates have a negative influence on the future gold prices and a positive influence on the future crude oil prices. In the long run, a relationship exists whereby interest rates influence the US dollar, which in turn influences international crude oil prices. A reduction in interest rates influences investor expectations with respect to depreciation of the dollar. Investors then move their capital to the gold market for capital preservation or speculation. Finally, international gold and crude oil prices have feedback effects on interest rates. This study found that crude oil prices increasing to a certain level trigger inflation, at which juncture the Fed may tighten monetary policies to downturn the bloom economy.

Ari and Jafari (2013) examined the gold price and the volatility of exchange rate from a descriptive analysis and the VAR model. This study shows that exchange rate fluctuations are also determined the changes of gold price. The study’s period refers to the ended five-year in December 2012. In this study examines the influence of variables such as the gold price on the market, the official exchange rate and non-official rate on the Iran’s market, the price of Brent crude oil, the global rate per ounce gold and foreign economic sanction. Vector auto regression model is used to

analyze the results of this study. The results indicate that gold price is affected from exchange rate fluctuations and global gold price, it is the most important factors affecting the recent volatility in the Iran's gold market and the exchange rate is the economic sanctions which have been imposed against Iran.

Subashini and Poornima (2014) studied that the relationship between gold price, exchange rate and crude oil price in India by using daily data for the period of 1st January 2009 to 31st December 2013. The Johansen cointegration test is used to find the relationship and the result shows that Indian Rupee, gold price and crude oil price has positive relationship together. That is, an increase in currency will increase crude oil price and gold price.

Bhunia and Pakira (2014) studied the impact of gold price and exchange rate on Sensex in India by using daily data from January 1991 to October 2013. The result of Johansen cointegration test reveals that there is a long run cointegrating relationship between the gold price and exchange rate. The investors are continuously watching the movements in gold price and exchange rate due to this reason.

Sinton (2014) investigated the long term association and causality between gold price, stock price and exchange rate in Jakarta. The study used the Johansen co-integration and causal relationship between the variables under study. The unit root test clarified that both gold price and stock price are non-stationary at their level and became stationary at the first differences in case of Augmented Dickey Fuller test (ADF). In this study showed that gold price, exchange rate and stock price does not have cointegration and long run equilibrium relationship among these variables. The Granger causality test finally confirmed that there is no causal relationship between gold price, exchange rate and stock price.

Gireesh et al. (2015) examined the cointegrating relationship between gold price and exchange rate in India. The study used the spot price of gold and exchange rate for the period of 2005-2013. In this study attempt to understand the impact of recession of 2008 on the relationship between gold price and exchange rate in India. This study uses the Johansen cointegration and causal relation between the variables. A separate pre, during and post-recession analysis of the variables is done to understand the impact of recession on this relationship. Therefore, in this study found that the long run cointegrating relationship between two variables of under study. As a result, the Granger causality test indicates that there exists bidirectional causality between exchange rate and gold price in India before the recession. However, the

during and post-recession have no causal and causal relationship between the gold price and exchange rate in India.

Singh and Sharma (2018) studied the cointegration and causality between the gold price, crude oil price, exchange rate and stock price in golbal fiancial crisis of 2008. In this study, Johansen cointegration test results found that there exists a long run equilibrium relationship between the variable in pre-crisis period. And post-crisis period does not exists the long run equilibrium relationship between under this study. Granger causality test results show that there is one-way causality from USD and Sensex to crude oil, and from gold and Sensex to USD. Thus, we conclude that the relationship among GODS is dynamic and has been affected by global financial crisis of 2008.

Nie and Jiang (2018) also tested the relationship between the gold price, US dollar and crude oil price. The study found that a long run cointegrating relationship exists between the variables. The gold price and US dollar have negative relationship and evidence of a positive non linear causal relationship from gold price to US dollar and a negative non linear causal relationship from US dollar to gold price.

Luo (2018) proposed that the causal relationship between stock indexes and exchange rates in group seven countries using the Granger causality test. The results also showed that there is no significant relationship between stock price indexes and exchange rates in these countries. When examining the impact of gold prices on stock markets and exchange rates, the results are different. In this study indicates that the three main findings. Firstly, there exists no significant long-run relationship between the stock price index and exchange rate in G7. Secondly, different types of short-run relationships exist between the stock price index and the exchange rate for the G7 countries. There exists a bidirectional relationship and the asymmetric effect is at different quantiles in Canada, Italy, and U.S.A. Besides, there exists a unidirectional relationship at different quantiles from the stock price index to the exchange rate in France and Japan. On the contrary there also exists a unidirectional relationship at different quantiles in the opposite direction for Germany and U.K. Thirdly, there exists international trading effects at different quantiles in Canada (at high quantile), Italy (at median quantile), and U.K. (at low quantile). On the other hand, there exists portfolio balance effects at different quantiles in Germany (at low and median quantiles) and U.S.A. (at high quantile). There exists neither effect in France and Japan. The empirical findings in this paper have important implications for

academicians, international institutional investors, and policymakers on the G7 markets.

Thakolsri (2021) described the relationship between gold price, oil price, foreign exchange rate and stock market index in Thailand by during the period from January 2000 to December 2018. This study investigated that there is exists short run cointegration and causal relationship between the gold price, oil price, foreign exchange rate and stock market index in Thailand. The monthly data obtained from a period of January 2000 to December 2018. Then, the Johansen cointegration test is conducted. And then, the normalized cointegrating coefficients are negative. Such empirical result shows that a significant long run relationship exists among variables. This study shows that the causal relationship between stock price to exchange rate and gold price to exchange rate in Thailand.

CHAPTER III
RESEARCH METHODOLOGY

In this chapter, the contents are divided into two parts. The first part explains the sources of data, and the second part presents descriptive statistics, Johansen cointegration and Granger causality test was used to check the cointegration and causal relationship between among these two variables.

3.1 Source of Data

This study aims at investigating the cointegration and causal relationship between gold price and exchange rate in Myanmar. In this study uses the monthly gold price and exchange rate data obtained from the authenticated sources of Selected Monthly Economic Indicators and Central Statistical Organization website for a period of 10 years from January 2011 to December 2020 with 120 observations.

3.2 Unit Root Tests

Before estimating the long-run relationship, both the variables are tested for their unit root test. Plotting the data and observing the graph is sometimes very useful because it can indicate clearly the presence or not of deterministic regressors. However, this procedure is the most sensible way to test for unit roots when the form of the data-generating process is unknown. In this present study, the Augmented Dickey-Fuller (ADF) Unit root test has been used to examine the stationarity of the data. The ADF Unit Root test is based on the null hypothesis Ho (the series is not stationary). If the calculated ADF statistic is less than the critical value, then the null hypothesis is rejected; otherwise accepted. If the variable is stationary at the first level, the variable is said to be integrated of order zero, I (0). If the variable is non-stationary at level, the ADF test can be utilized and the first difference of the variable can be used for testing a unit root. In this case, the variable is said to be co-integrated of order one, I (1).

(i) Augmented Dickey Fuller Test

Dickey and Fuller (1979, 1981) devised a formal procedure to test for non-stationarity. The key insight of their test is that testing for non-stationarity is equivalent to testing for the existence of a unit root. Thus the obvious test is the following, which is based on the simple AR (1) model of the form:

$$y_t = \varphi y_{t-1} + ut \tag{3.1}$$

To examine here is whether φ is equal to 1 (unity and hence 'unit root'). Obviously, the null hypothesis H_0: φ = 1, and the alternative hypothesis H_1: φ < 1. A different (more convenient) version of the test can be obtained by subtracting y_{t-1} from both sides of Equation

$$y_t - y_{t-1} = (\varphi - 1)\, y_{t-1} + u_t \tag{3.2}$$

$$\Delta y_t = (\varphi - 1)\, y_{t-1} + u_t \tag{3.3}$$

$$\Delta y_t = \gamma\, y_{t-1} + u_t \tag{3.4}$$

where of course γ = (φ − 1). Now the null hypothesis is H0: γ = 0 and the alternative hypothesis Ha: γ < 0, where if γ = 0 then y_t follows a pure random-walk model. Dickey and Fuller (1979) also proposed two alternative regression equations that can be used for testing for the presence of a unit root. The first contains a constant in the random-walk process, as in the following equation:

$$\Delta y_t = \alpha_0 + \gamma\, y_{t-1} + u_t \tag{3.5}$$

This is an extremely important case, because such processes exhibit a definite trend in the series when γ = 0 which is often the case for macroeconomic variables. The second case is also to allow a non-stochastic time trend in the model, to obtain:

$$\Delta y_t = \alpha_0 + a_{2t} + \gamma\, y_{t-1} + ut \tag{3.6}$$

The DF test for stationarity is then simply the normal t-test on the coefficient of the lagged dependent variable y_{t-1} from one of the three models. This test does not, however, have a conventional t-distribution and so we must use special critical values originally calculated by Dickey and Fuller.

MacKinnon (1991) tabulated appropriate critical values for each of the three models discussed above and these are presented in Table (3.1).

Table (3.1) Critical Values for the Dickey–Fuller Test

Model	1%	5%	10%
$\Delta y_{t-1} = \gamma y_{t-1} + u_t$	−2.56	−1.94	−1.62
$\Delta y_{t-1} = \alpha_0 + \gamma y_{t-1} + u_t$	−3.43	−2.86	−2.57
$\Delta y_{t-1} = \alpha_0 + a_{2t} + \gamma y_{t-1} + u_t$	−3.96	−3.41	−3.13
Standard critical values	−2.33	−1.65	−1.28

Source: MacKinnon (1991)

In all cases, the test focuses on whether $\gamma = 0$. The DF test statistic is the t-statistic for the lagged dependent variable. If the DF statistical value is smaller than critical value and the null hypothesis of a unit root is rejected and conclude that y_t is a stationary process.

As the error term is unlikely to be white noise, Dickey and Fuller extended their test procedure by suggesting an augmented version of the test that includes extra lagged terms of the dependent variable in order to eliminate autocorrelation. The lag length on these extra terms is either determined by the Akaike information criterion (AIC) or the Schwartz Bayesian criterion (SBC), or more usefully by the lag length necessary to whiten the residuals (that is after each case we check whether the residuals of the ADF regression are auto correlated or not through a Lagrange multiplier (LM) tests rather than the Durbin-Watson (DW) test). The three possible forms of the ADF test are given by the following equations:

$$\Delta y_t = \gamma y_{t-1} + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + u_t \quad (3.7)$$

$$\Delta y_t = \alpha_0 + \gamma y_{t-1} \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + u_t \quad (3.8)$$

$$\Delta y_t = a_0 + \gamma y_{t-1} + a_{2t} + \sum_{i=1}^{p} \beta_i \Delta y_{t-i} + u_t \quad (3.9)$$

The difference between the three regressions again concerns the presence of the deterministic elements a_0 and a_{2t}. The critical values for the ADF tests are the same as those given in Table 3.1 for the DF test. Unless the econometrician knows the actual data-generating process, there is a question concerning whether it is most appropriate to estimate equation. Doldado et al. (1990) suggest a procedure which starts from the estimation of the most general model given by Equation, answering a

set of questions regarding the appropriateness of each model and then moving to the next model.

(ii) Phillips Perron Test

The distribution theory supporting the DF and ADF tests is based on the assumption that the error terms are statistically independent and have a constant variance. So, when using the ADF methodology, one has to make sure that the error terms are uncorrelated and that they really do have a constant variance. Phillips and Perron (1988) developed a generalization of the ADF test procedure that allows for fairly mild assumptions concerning the distribution of errors. The test regression for the PP test is the AR (1) process:

$$\Delta y_{t-1} = \alpha_0 + \gamma\, y_{t-1} + e_t \qquad (3.10)$$

While the ADF test corrects for higher-order serial correlation by adding lagged differenced terms on the right-hand side, the PP test makes a correction to the t statistic of the coefficient γ from the AR (1) regression to account for the serial correlation in e_t. So the PP statistics are only modifications of the ADF t-statistics that take into account the less restrictive nature of the error process. The expressions are extremely complex to derive and are beyond the scope of this text. However, since many statistical packages (one of them is E-Views) have routines available to calculate these statistics, it is good for the researcher to test the order of integration of a series by also performing the PP test. The asymptotic distribution of the PP t-statistic is the same as the ADF t-statistic and therefore the MacKinnon (1991) critical values are still applicable. As with the ADF test, the PP test can be performed with the inclusion of a constant, a constant and a linear trend, or neither in the test regression.

3.3 Setting the Optimal Lag Length of the Model

In economics, the dependence of a variable *Y* (outcome variable or regress and) on another variable(s) *X* (the predictor variable or regressor) is rarely instantaneous. Furthermore, *Y* responds to *X* with a lapse of time. Such a lapse of time is called a *lag*.

The issue of finding the appropriate (optimal) lag length is very important because we want to have Gaussian error terms (that is standard normal error terms that do not suffer from non-normality, autocorrelation, heteroskedasticity and so on).

Setting the value of the lag length is affected by the omission of variables that might affect only the short-run behavior of the model. This is because omitted variables instantly become part of the error term. Therefore, very careful inspection of the data and the functional relationship is necessary before proceeding with estimation, to decide whether to include additional variables. It is quite common to use dummy variables to take into account short-run 'shocks' to the system, such as political events that had important effects on macroeconomic conditions.

The most common procedure in choosing the optimal lag length is to estimate a Vector Autoregressive (VAR) model including all our variables in levels (non-differenced data). This VAR model should be estimated for a large number of lags, then reducing down by re estimating the model for one lag less until zero lags are reached (that is to estimate the model for 12 lags, then 11, then 10 and so on until reach 0 lags). In each of these models inspect the values of the AIC and the SBC criteria, as well as the diagnostics concerning autocorrelation, heteroskedasticity, possible Autoregressive Conditional Hetroskedasticity (ARCH) effects and normality of the residuals. In general, the model that minimizes AIC and SBC is selected as the one with the optimal lag length. This model should also pass all the diagnostic checks.

3.4 Vector Autoregressive Model

It is quite common in economics to have models in which some variables are not only explanatory variables for a given dependent variable, but are also explained by the variables that they are used to determine. In these case, the models have simultaneous equations, in which it is necessary to identify clearly which are the endogenous and which are the exogenous or predetermined variables.

The decision regarding such a differentiation among variables was heavily criticized by Sims (1980). According to Sims, if there is simultaneity among a number of variables, then all these variables should be treated in the same way. In other words, there should be no distinction between endogenous and exogenous variables. Therefore, once this distinction is abandoned, all variables are treated as endogenous. This means that in its general reduced form each equation has the same set of regressors, which leads to the development of VAR models.

When there are not confident that a variable really is exogenous, each variable has to be treated symmetrically. The time series y_t that is affected by current and past values of x_t and, simultaneously, the time series x_t to be a series that is affected by

current and past values of the y_t series. In this case the simple bivariate model is given by:

$$y_t = \beta_{10} - \beta_{12}x_t + \gamma_{11}y_{t-1} + \gamma_{12}x_{t-1} + u_{yt} \quad (3.11)$$

$$x_t = \beta_{20} - \beta_{21}y_t + \gamma_{21}y_{t-1} + \gamma_{22}x_{t-1} + u_{xt} \quad (3.12)$$

where we assume that both yt and xt are stationary, and uyt and uxt are uncorrelated white-noise error terms. Equations constitute a first-order VAR model, because the longest lag length is unity. These equations are not reduced-form equations, since y_t has a contemporaneous impact on xt (given by $-\beta_{21}$), and x_t has a contemporaneous impact on y_t (given by $-\beta_{12}$). Rewriting the system using matrix algebra, we get:

$$\begin{bmatrix} 1 & \beta_{12} \\ \beta_{21} & 1 \end{bmatrix} \begin{bmatrix} \gamma_t \\ X_t \end{bmatrix} = \begin{bmatrix} \beta_{10} \\ \beta_{20} \end{bmatrix} + \begin{bmatrix} \gamma_{11} & \gamma_{12} \\ \gamma_{21} & \gamma_{22} \end{bmatrix} \begin{bmatrix} \gamma_{t-1} \\ X_{2t-1} \end{bmatrix} + \begin{bmatrix} u_t \\ u_{Xt} \end{bmatrix} \quad (3.13)$$

$$Bz_t = \Gamma_0 + \Gamma_1 Z_{t-1} + u_t \quad (3.14)$$

$$B = \begin{bmatrix} 1 & \beta_{12} \\ \beta_{21} & 1 \end{bmatrix}, z_t = \begin{bmatrix} \gamma_t \\ X_t \end{bmatrix}, \gamma_0 = \begin{bmatrix} \beta_{10} \\ \beta_{20} \end{bmatrix} \quad (3.15)$$

$$\gamma_1 = \begin{bmatrix} \gamma_{11} & \gamma_{12} \\ \gamma_{21} & \gamma_{22} \end{bmatrix}, and\ u_t = \begin{bmatrix} u_t \\ u_{Xt} \end{bmatrix} \quad (3.16)$$

Multiplying both sides by B^{-1} we obtain: $z_t = A_0 + A_1 z_{t-1} + e_t$ (3.17)

where $A_0 = B_{-1}\Gamma_0$, $A_1 = B^{-1}\Gamma_1$, and $e_t = B^{-1}u_t$. For purposes of notational simplification can denote as a_{i0}; the i^{th} element of the vector A_0; a_{ij} the element in row i and column j of the matrix A_1; and eit as the ith element of the vector e_t. Using this, we can rewrite the VAR model as:

$$y_t = a_{10} + a_{11}y_{t-1} + a_{12}x_{t-1} + e_{1t} \quad (3.18)$$

$$x_t = a_{20} + a_{21}y_{t-1} + a_{22}x_{t-1} + e_{2t} \quad (3.19)$$

To distinguish between the original VAR model and the system have just obtained, the first a structural or primitive VAR system and the second a VAR in standard (or reduced) form. It is important to note that the new error terms, e_{1t} and e_{2t}, are composites of the two shocks uy_t and ux_t. Since $e_t = B^{-1}ut$ we can obtain e_{1t} and e_{2t} as:

$$e_{1t} = (uy_t + \beta_{12}ux_t)/(1 - \beta_{12}\beta_{21}) \quad (3.20)$$

$$e_{2t} = (ux_t + \beta_{21}uy_t)/(1 - \beta_{12}\beta_{21}) \quad (3.21)$$

Since uy_t and ux_t are white-noise processes, it follows that both e_{1t} and e_{2t} are also white-noise processes.

The VAR model approach has some very good characteristics. First, it is very simple. The econometrician does not have to worry about which variables are endogenous or exogenous. Second, estimation is also very simple, in the sense that each equation can be estimated separately with the usual OLS method. Third, forecasts obtained from VAR models are in most cases better than those obtained from the far more complex simultaneous equation models (see Mahmoud, 1984; McNees, 1986).

However, on the other hand, VAR models have faced severe criticism over various points. First, they are atheoretic, in that they are not based on any economic theory. Since initially there are no restrictions on any of the parameters under estimation, in effect 'everything causes everything'. However, statistical inference is often used in the estimated models so that some coefficients that appear to be insignificant can be dropped, in order to lead to models that might have an underlying consistent theory. Such inference is normally carried out using what are called causality tests.

3.5 Johansen Cointegration Test

According to Johansen (1988) and Johansen and Juselius (1990), there are two methods (and corresponding test statistics) for determining the number of cointegrating relations, and both involve estimation of the matrix Γ. This is a k × k matrix with rank r. The procedures are based on propositions about Eigen values. The Johansen's cointegration test has been applied to check whether the long-run equilibrium relation exists between the variables. The Johansen approach, cointegration test is based on the two test statistics, viz., the trace test statistic and the maximum Eigen value test statistic.

(i) The Maximum Eigen Value Test

One method tests the null hypothesis, that Rank (Γ) = r against the hypothesis that the rank is r + 1. So the null in this case is that there are cointegrating vectors and there are up to r cointegrating relationships, with the alternative suggesting that there are (r + 1) vectors. The test statistics are based on the characteristic roots (also called eigenvalues) obtained from the estimation procedure. The test consists of ordering the largest eigenvalues in descending order and considering whether they are significantly

different from zero. To understand the test procedure, obtained n characteristic roots denoted by $\lambda_1 > \lambda_2 > \lambda_3 > \cdots > \lambda_n$. If the variables under examination are not cointegrated, the rank of Γ is zero and all the characteristic roots will equal zero. Therefore $(1 - \widehat{\lambda_i})$ will be equal to 1 and, since ln (1) = 0, each of the expressions will be equal to zero for no cointegration. On the other hand, if the rank of Γ is equal to 1, then $0 < \lambda_1 < 1$ so that the first expression is $(1 - \widehat{\lambda_i}) < 0$, while all the rest will be equal to zero. To test how many of the numbers of the characteristic roots are significantly different from zero this test uses the following statistic:

$$\lambda max(r,r+1) = -T\, ln(1 - \hat{\lambda}_{r+1}) \qquad (3.22)$$

As noted above, the test statistic is based on the maximum eigenvalue and is thus called the maximal eigenvalue statistic (denoted by λmax).

(ii) The Trace Test

The second method is based on a likelihood ratio test for the trace of the matrix (and because of that it is called the trace statistic). The trace statistic considers whether the trace is increased by adding more eigenvalues beyond the rth. The null hypothesis in this case is that the number of cointegrating vectors is less than or equal to r. From the previous analysis it should be clear that when all λˆ i = 0, then the trace statistic is also equal to zero. On the other hand, the closer the characteristic roots are to unity, the more negative is the ln (1 − λˆ i) term and therefore the larger the trace statistic. This statistic is calculated by:

$$\lambda trace(r) = -T \sum_{i=r+1}^{n} Ln\,(1 - \hat{\lambda}_{r+1}) \qquad (3.23)$$

The usual procedure is to work downwards and stop at the value of r, which is associated with a test statistic that exceeds the displayed critical value. Critical values for both statistics are provided by Johansen and Juselius (1990) (these critical values are directly provided from both EViews and Microfit after conducting a test for cointegration using the Johansen approach).

3.6 Granger Causality Test

One of the good features of VAR models is that they allow us to test for the direction of causality. Causality in econometrics is somewhat different from the concept in everyday use; it refers more to the ability of one variable to predict (and therefore cause) the other.

Suppose two variables, say y_t and x_t, affect each other with distributed lags. The relationship between these variables can be captured by a VAR model. In this case it is possible to state that (a) y_t causes x_t; (b) x_t causes y_t; (c) there is a bi-directional feedback (causality among the variables); and (d) the two variables are independent. The problem is to find an appropriate procedure that allows us to test and statistically detect the cause and effect relationship among the variables.

Granger (1969) developed a relatively simple test that defined causality as follows: a variable y_t is said to Granger cause x_t if x_t can be predicted with greater accuracy by using past values of the y_t variable rather than not using such past values, all other terms remaining unchanged. The next section presents the Granger causality test, and this will be followed by an alternative causality test developed by Sims (1972).

The Granger causality test for the case of two stationary variables y_t and x_t involves as a first step the estimation of the following VAR model:

$$y_t = a_1 + \sum_{i=0}^{n} \beta_i x_{t-i} + \sum_{j=0}^{m} \gamma_j y_{t-j} + e_{1t} \quad (3.24)$$

$$x_t = a_2 + \sum_{i=0}^{n} \theta_i x_{t-i} + \sum_{j=0}^{m} \delta_j y_{t-j} + e_{2t} \quad (3.25)$$

where it is assumed that both εy_t and εx_t are uncorrelated white-noise error terms.

Granger causality test of hypotheses are as follows:

The Null Hypotheses

(H_0): There is no cause and effect (Granger causality) between the two variables.

If the (probability) p > 5%, then the null hypothesis (H_0) is accepted.

The Alternative Hypotheses

(H_1): There is a cause and effect (Granger causality) between the two variables.

If the (probability) p < 5%, then null hypothesis (H_0) is rejected.

Since the probabilities of all different periods are more the 5% then there is no Granger causality between the two variables. To underline the causal direction between the variables, a pairwise Granger causality test has been conducted. In testing the pairwise Granger causality, at least two variables are usually analyzed together while testing for their interaction.

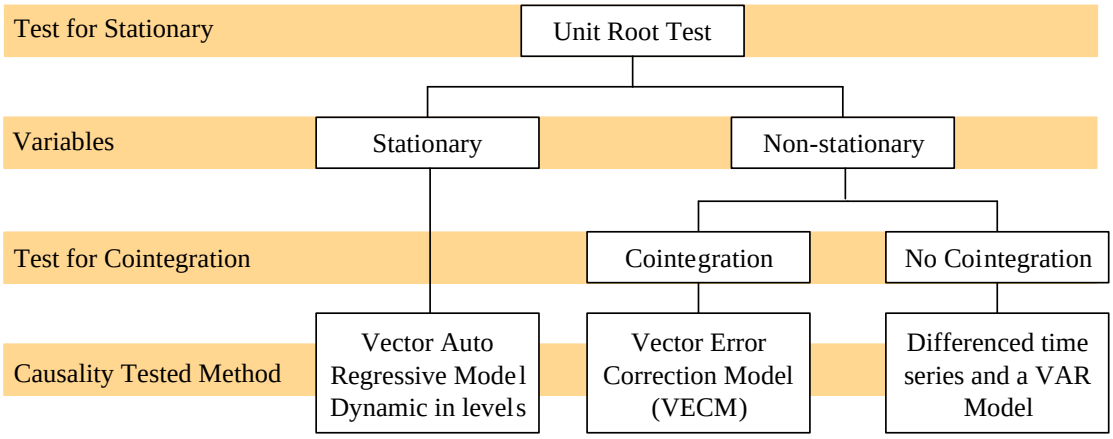
Following are the possible results of the analyzes:

- Unidirectional Granger Causality from variable Y_t to variable X_t
- Unidirectional Granger Causality from variable X_t to variable Y_t
- Bi-directional Granger Causality and No Causality.

3.7 Procedure of Causality Testing

The Figure (3.1) shows the procedure of causality testing that required for long, short and relationship between gold price and exchange rate.

Figure (3.1) Procedure of Causality Testing



Source: Own Completion from Shahid Bukhari, (2020).

CHAPTER IV
ANALYSIS OF THE CAUSALITY BETWEEN GOLD PRICE AND EXCHANGE RATE IN MYANMAR

This chapter describes the results and findings. Results of the study are presented in two sections; the first section is the descriptive statistical analysis. The second section is the presentation of econometric analysis by mainly using Unit Root test, Johansen Cointegration and Granger Causality test were used to analyze the relationship between gold price and exchange rate in Myanmar.

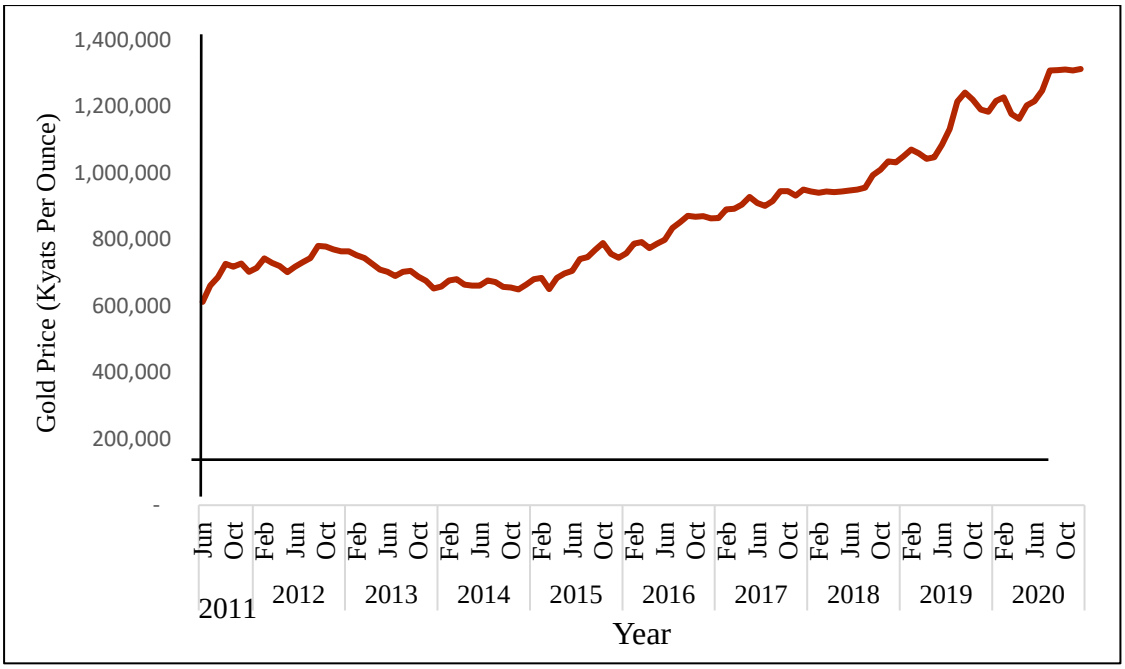
4.1 Descriptive Statistics of Gold Price and Exchange Rate in Myanmar

In this study, monthly average gold price (Kyats per Ounce) and monthly average exchange rate (Kyats per US Dollar) are presented in Tables (4.1), (4.2) and Figures (4.1), (4.2).

Table (4.1) Monthly Average Gold Price (Kyats per Ounce) in Myanmar

Year/ Month	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
Jan	634,367	713,812	764,731	658,135	680,033	758,740	864,180	944,136	1,050,948	1,217,833
Feb	652,022	742,860	752,783	676,352	684,050	787,708	890,563	940,922	1,070,978	1,227,896
Mar	669,923	729,438	743,705	680,552	650,778	792,300	892,528	945,042	1,059,125	1,178,043
April	670,353	719,667	726,472	664,271	683,944	774,382	905,452	942,633	1,042,705	1,163,300
May	668,360	702,108	709,284	661,084	697,500	787,608	928,050	945,026	1,047,588	1,204,188
June	612,127	718,154	702,908	660,820	705,260	798,846	910,050	947,050	1,084,932	1,216,685
July	661,083	731,720	690,172	676,780	741,250	834,860	901,064	950,133	1,132,832	1,248,700
Aug	686,315	744,346	702,641	671,665	747,320	851,848	916,041	955,892	1215,558	1,309,300
Sept	727,	780,988	705,580	657,115	769,548	870,980	945,442	994,244	1,242,720	1,310,135
Oct	718,125	778,935	688,135	655,080	789,308	868,135	945,442	1,009,813	1,221,091	1,311,958
Nov	727,813	770,271	675,592	649,458	756,309	870,438	931,648	1,034,817	1,191,326	1,308,605
Dec	702,241	764,392	652,560	664,038	744,638	863,704	950,400	1,031,978	1,184,152	1,313,375
Minim	612,127	702,108	652,560	649,458	650,778	758,740	864,180	940,922	1,042,705	1,163,300
Maxi	727,813	780,988	764,731	680,552	789,308	870,980	945,442	1,034,817	1,242,720	1,313,375

Source: Central Statistical Organization (CSO) Myanmar


1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
-
Gold Price (Kyats Per Ounce)
Jun Oct Feb Jun Oct Feb Jun Oct Feb Jun Oct Feb Jun Oct Feb Jun Oct Feb Jun Oct Feb Jun Oct Feb Jun Oct Feb Jun Oct
2011 2012 2013 2014 2015 2016 2017 2018 2019 2020
Year

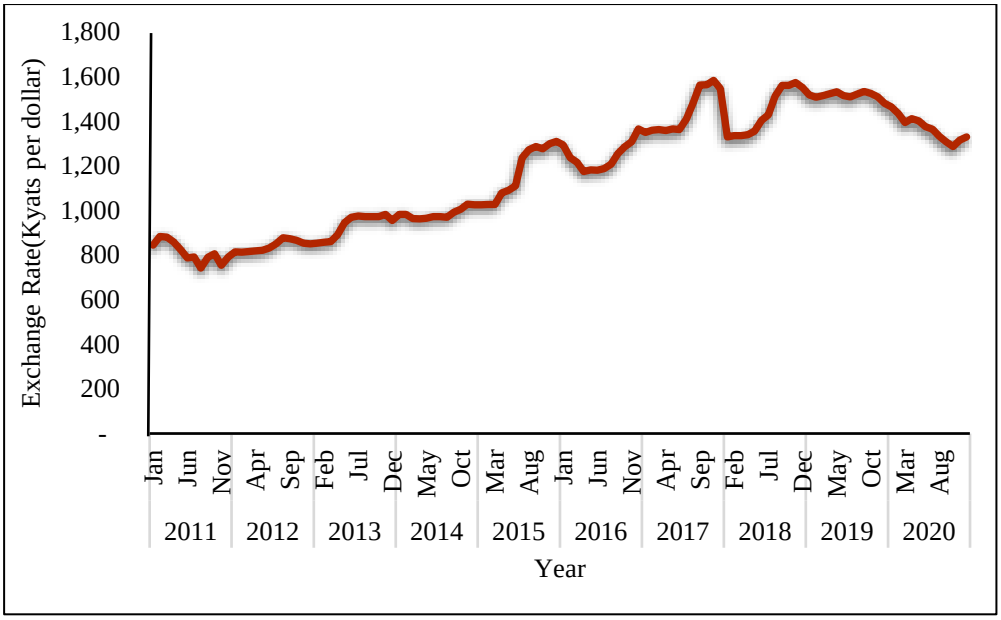
Source: Central Statistical Organization (CSO) Myanmar.

Figure (4.1) Gold Price (Kyats per Ounce) in Myanmar

Table (4.2) Monthly Average Exchange Rate (Kyats per US Dollar) in Myanmar

Years/ Month	2011	2012	2013	2014	2015	2016	2017	2018	2019	2020
January	845	815	854	983	1025	1294	1350	1330	1518	1465
February	883	813	858	982	1027	1237	1360	1336	1508	1434
March	881	816	860	964	1027	1216	1362	1335	1515	1395
April	859	819	890	962	1078	1175	1358	1340	1523	1411
May	826	822	945	966	1090	1182	1365	1355	1533	1401
June	787	832	969	973	1110	1181	1362	1405	1515	1375
July	792	850	975	972	1236	1187	1410	1429	1510	1364
August	742	878	972	970	1273	1208	1482	1512	1522	1332
September	790	874	973	992	1287	1255	1562	1560	1533	1309
October	806	866	972	1006	1277	1285	1563	1560	1526	1287
November	755	854	983	1028	1300	1308	1583	1573	1509	1315
December	791	851	955	1026	1309	1365	1547	1550	1480	1329
Minimum	742	813	854	962	1025	1175	1350	1330	1480	1309
Maximum	883	878	983	1028	1309	1365	1366	1573	1533	1465

Source: Central Statistical Organization (CSO) Myanmar



Source: Central Statistical Organization (CSO) Myanmar

Figure (4.2) Exchange Rate (Kyats per US Dollar) in Myanmar

The maximum, minimum and average value of gold price over the month starting from January 2011 to December 2020 are shown in Table (4.1). Over the ten-year period, the table indicates that the average value for gold price in 2020 is the highest in December. Comparing every month of each year, the average value of gold price is highest in 2020 December. The maximum and minimum values of gold price are 1,313,375 kyats per ounce in 2020 December and 612,127 kyats per ounce in 2011 June. This is the time for investors in Myanmar's and most of them are making a jewelry for saving and capital for the next year.

The maximum, minimum and average value of exchange rate over the month starting from January 2011 to December 2020 are shown in Table (4.2). Comparing every month of each year, the average value of exchange rate in Myanmar is peaked on November. Over the ten-year period, the table indicates the average value of foreign exchange rate in 2017 November is the highest and 2011 August is the lowest. Comparing every month of each year, the maximum and minimum values of foreign exchange rate are 1583 kyats per US dollar in 2017 November and 742 kyats per US dollar in 2011 August.

To know the nature of these two variables within the period of the research, descriptive statistics was analyzed. The summarizes basic techniques of exchange rate and gold price in Myanmar are illustrated in Table (4.3).

Table (4.3) Descriptive Statistics of Gold Price and Exchange Rate in Myanmar

Description	Gold Price (Kyats per Ounce)	Exchange Rate (Kyats per US Dollar)
Mean	1175.032	860017.033
Median	1226	779961.5
Mode	972	945442
Standard Deviation	261.769	197225.047
Kurtosis	-1.454	-0.386
Skeweness	-0.047	0.867
Range	841	701248
Minimum	742	612127
Maximum	1583	1313375
Sum	141003.8	103202044
Observation	120	120

Source: Central Statistical Organization (CSO) Myanmar

According to the Table (4.3), the standard deviation of exchange rate is lowest and that of gold price is highest. The two variables of the mean value are positive. Exchange rate has the negative value and their median is greater than mean to indicating that the distribution is positively skewed or right skewed. Since, the gold price is positive value and the median is less than mean to indicates that the distribution is negatively skewed or skewed to the left. The kurtosis of the exchange rate and gold price is less than one to indicates that the shape of distribution is flatter distribution.

A general guideline for skewness is that if the number is greater than +1 or lower than -1, this is an indication of a substantially skewed distribution. For kurtosis, the general guideline is that if the number is greater than +1, the distribution is too peaked. Likewise, a kurtosis of less than -1 indicates a distribution that is too flat. Distribution exhibiting skewness and kurtosis that exceed these guidelines are considered non-normal (Hair et al., 2017). To examine the non-stationary property of the series, this study used unit root test such as: Augmented Dicky Fuller test and Phillips Perron test.

4.2 Testing the Stationary of Gold Price and Exchange Rate in Myanmar

Before investigating the causality test among the variables, it's necessary to determine whether the study's variables are stationary or non-stationary. In this study there are two different forms of unit root tests such as Augmented Dicky Fuller test and Phillips Perron test are employed for all the variables.

H_0: The gold price and exchange rate have unit root. (Non-stationary)

H_1: The gold price and exchange rate haven't unit root (Stationary)

The results of Augmented Dicky Fuller test and Phillips Perron test at level are presented in Table (4.4).

Table (4.4) Testing the Stationary of Gold Price and Exchange Rate in Myanmar

Variables	ADF Test		PP Test		Critical Value		
	t-stat	Prob.*	t-stat	Prob.*	1%	5%	10%
ER	-1.174	0.684	-1.200	0.673	-3.486	-2.886	-2.580
ΔER	-7.995	0.000	-8.006	0.000	-3.486	-2.886	-2.580
GP	1.212	0.999	1.444	0.999	-3.487	-2.886	-2.580
ΔGP	-7.900	0.000	-8.483	0.000	-3.487	-2.886	-2.580

Source: Central Statistical Organization (CSO) Myanmar.

According to the Table (4.4), for the variable of gold price, the ADF test statistic for gold price is greater than the critical value at the probability value of 0.999 which is greater than 5%, the null hypothesis is accepted. Therefore, the first difference of gold price are tested for unit root as the next step. Here, the ADF test statistic value at first difference is than critical value at the probability value less than 1%. Therefore, the rejection of null hypothesis supports the stationary of gold price at first difference at I (1) level. The Phillips Perron (PP) test also give the same result.

According to the ADF test statistic for exchange rate value is greater than the critical value at the probability value of 0.684 which is greater than 5%, the null hypothesis is accepted. Therefore, the first difference of exchange rate are tested for unit root as the next step. Here, the ADF test statistic value at first difference is less than critical value at the probability value less than 1%. Therefore, the rejection of null hypothesis supports the stationary of exchange rate at first difference at I (1) level. The Phillips Perron (PP) test also give the same result.

4.3 Lag Length Selection of Gold Price and Exchange Rate in Myanmar

At the time series are integrated with the same order, the next test is to detect whether there exists a long run relationship between them. It can be estimated through Johansen cointegration test. Prior to apply the cointegration test, the optimal lag length of the model must be determined. Number of criteria such as Hannan-Quinn Information (HQ), Akaike Information Criteria (AIC) and Schwarz Information Criteria (SIC) are used to detect the lag length. The lag specification criteria results are showed in Table (4.5).

Table (4.5) Lag Length Selection of Gold Price and Exchange Rate in Myanmar

Lag	Log L	LR	FPE	AIC	SC	HQ
0	-2255.190	NA	1.10e+15	40.30696	40.35550	40.32665
1	-1820.307	846.4673	5.00e+11	32.61263	32.75826*	32.67172
2	-1811.323	17.16618*	4.57e+11*	32.52363*	32.76635	32.62211*
3	-1807.765	6.672224	4.61e+11	32.53151	32.87132	32.66938
4	-1805.956	3.326199	4.79e+11	32.57065	33.00755	32.74791
5	-1801.313	8.375052	4.74e+11	32.55915	33.09314	32.77581
6	-1798.924	4.222469	4.88e+11	32.58793	33.21901	32.84398
7	-1797.859	1.844671	5.15e+11	32.64034	33.36851	32.93578
8	-1795.336	4.281099	5.30e+11	32.66671	33.49196	33.00154

Source: Central Statistical Organization (CSO) Myanmar.

* indicates lag order selected by the criterion.

From Table (4.5), the optimal lag length of the model is lag two. A VAR model of order p=2 is the appropriate model to use. Different lag length selection criteria lead to different conclusion. And then, the results of Johansen cointegration test are presented in Table (4.6).

4.4 Johansen Cointegration Test of Gold Price and Exchange Rate in Myanmar

Since, the Johansen Cointegration test is applied to determine whether there is cointegration as well as whether there are long run relationship between gold price and

exchange rate. The results of Johansen Cointegration test results are presented in Table (4.6).

H_0: There is no long run relationship between gold price and exchange rate.

H_1: There is long run relationship between gold price and exchange rate.

Table (4.6) Results of Cointegration Test for Gold Price and Exchange Rate in Myanmar

Unrestricted Cointegration Rank Test (Track)				
Hypothesized		Trace	0.05	
No of CE(s)	Eigen Value	Statistic	Critical Value	Prob.**
None	0.029530	3.624739	15.49471	0.9315
At Most 1	0.000744	0.087799	3.841466	0.7670
Unrestricted Cointegration Rank Test (Maximum Eigen Value)				
Hypothesized		Trace	0.05	
No of CE(s)	Eigen Value	Statistic	Critical Value	Prob.**
None	0.029530	3.536993	14.26460	0.9047
At Most 1	0.000744	0.087799	3.841466	0.7670

Source: Central Statistical Organization (CSO) Myanmar

Trace test indicates no cointegration at the 0.05 level.

*denotes rejection of the hypothesis at the 0.05 level.

** Mackinnon-Haug-Michelis (1999) p-values.

Maximum Eigenvalue test indicates no cointegration at the 0.05 level.

*denotes rejection of the hypothesis at the 0.05 level.

** Mackinnon-Haug-Michelis (1999) p-values.

According to the results of Johansen Cointegration test is conducted, the null hypothesis states that there is no cointergating relationship between the two variables under study. The alternative hypothesis shows that there is conintegrating in at most one case. In this study, the results indicating that the hypothesis is accepted since the corresponding p value is more than 5%. In this case, the Eigen values are also give the same result. Therefore, it can be concluded that the two variables have long run relationship under study.

Since, the two variables have long run relationship, the Granger causality test was conducted to check lag lead relationship between them. Since, the data series becomes stationary at first difference, the test uses the first difference of the original

series. The test is conducted at lag which showed the Minimum Akaike Information Criteria (AIC). The Minimum value of AIC helps up to know that the optimal lag is selected while conducting the Granger causality test.

4.5 Causality Between Gold Price and Exchange Rate in Myanmar

The Granger Causality test is employed to identify the causal relationship between the two variables of gold price and exchange rate in Myanmar. As the p value of one variable, exchange rate was significantly to forecast the value of the variable of gold price, then it can be stated that the exchange rate granger cause with the gold price. The results of Pairwise Granger Causality test are showed in the Table (4.7).

H_0: There is no causal relationship between gold price and exchange rate.

H_1: There is a causal relationship between gold price and exchange rate.

Table (4.7) Results of Causality Between Gold Price and Exchange Rate in Myanmar

Particular	Obsevation	F-statistics	Prob.**
Null hypothesis			
Gold Price does not Granger cause Exchange Rate	117	2.88489	0.0600
Exchange Rate does not Granger cause Gold Price	117	0.17442	0.8402

Source: Central Statistical Organization (CSO) Myanmar.

According to the Table (4.7), result revels that the gold price and exchange rate have relationship between each other, since the probability value (0.0600) is less than 10%. Here, the null hypothesis is rejected and the accepted the alternative hypothesis, there is a relationship between the gold price and exchange rate. The results also reveal that exchange rate to gold price does not have significant relationship because the probability value is greater than 5%, here the null hypothesis is accepted, the exchange rate does not Granger cause the gold price. Therefore, the test result shows a unidirectional relationship between the variables.

CHAPTER V
CONCLUSION

This chapter describes the findings and discussion for this study. Then, suggestions and recommendations and advices for further researchers are also mentioned in this chapter.

5.1 Findings and Discussions

The main objectives of this study is to analyze the cointegration and causal relationship between exchange rate and gold price in Myanmar. To attain that objective, Unit Root tets scuch as Augmented Dicky Fuller and Phillip Perron tests for stationary of the time series,Vector Autoregrassive (VAR) model, Johansen cointegration test and Granger Casuality test have been used.

According to the descriptive statistics, it is found that the variables of gold price and exchange rate are highest in 2020 December and 2017 November. In addition to, the lowest value of gold price and exchange rate occur in 2011 June and August. Furthermore, in this study observed that the unit root test was used to test gold price exchange rate are stationary or not. And then, in this study observed that the variables of gold price and exchange rate are stationary at first difference. The similar findings was found in (Ranjusha., et al, 2017) study, which showed that gold price and exchange rate are stationary at first difference.

In this study found that the Vector Autoregressive (VAR) lag length selection of the model is lag two and different lag selection criteria lead to the different conclusion. Then, Johansen cointegration test used to find out the long run relationship, if any exists between gold price and exchange rate. The study found that there exists a long run cointegrating relationship between gold price and exchange rate in Myanmar. The similar findings was found in (Girish, 2015) study, which showed that there is a long run cointegrating relationship between gold price and exchange rate in India.

According to the Granger causality test, the findings was found that there is a unidirectional relationship between gold price and exchange rate in Myanmar during the study period. The similar findings was found in (Gayathri, 2014) study, which shows that the unidimensional relationship between gold price and NSE Nify index.

5.2 Suggestions and Recommendations

It is suggested by the financial advisors to invest in gold when the exchange rates fall. Similarly, investments in gold are not preferred as the returns from investment in foreign currencies are comparatively higher. In addition to, some investors believed that gold prices had no portfolio risk aversion value and can be treated like any other commodity whose price changes were strictly determined by supply and demand.

Similarly, the movement of exchange rate has impact on Myanmar which is a become globalization country. Reason for appreciation of exchange rate in Myanmar accordance with global economies. In the fast of the provided the appreciation of dollar in Myanmar or dollar demand and supply in Myanmar, dollar demand is more than supply. When the review of demand site according to export import measurement, import is larger than export. Alternatively, the supply is reviewed that it encompasses not only product export but also foreign earning service export such as hotel and transportation, foreign investment companies and non-governmental organization and remittances of migrated labours in foreign country.

Due to appreciation of US dollar, there may be both positive and negative impact on Myanmar economy. Therefore, the exchange rate of USD should be taken into consideration while takens any investment decision in the metal.

5.3 Needs for Further Study

This study places particular emphasis on the spot price of gold and foreign exchange rate in Myanmar.The time series data are gathered by the Central Statistical Organization from selected monthly economic indicators in Myanmar. The essential roles of other economic indicators such as gold price, rice price, crude oil price, discel price, commodity price, stock price, inflation rate and foreign exchange rate that can affect the price of gold needs to be further studieds in order

to identify a model with a reduced prediction error. A Granger Casuality test-related econometric model will also be used for analysis and interpretation. Using the findings of this study more researchers will forecast and determine the distributed lag, simple linear regression, multiple linear regression, forecasting and time series analysis of the ARIMA and GARCH models.

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APPENDICES

Null Hypothesis: GOLD_PRICE has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		1.212058	0.9981
Test critical values:	1% level	-3.487046	
	5% level	-2.886290	
	10% level	-2.580046	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GOLD_PRICE)
Method: Least Squares
Date: 11/18/22 Time: 13:20
Sample (adjusted): 2011M04 2020M12
Included observations: 117 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GOLD_PRICE(-1)	0.012629	0.010419	1.212058	0.2280
D(GOLD_PRICE(-1))	0.228952	0.093671	2.444216	0.0161
D(GOLD_PRICE(-2))	-0.186467	0.094263	-1.978169	0.0503
C	-5564.282	8977.603	-0.619796	0.5366

R-squared	0.083083	Mean dependent var	5499.590
Adjusted R-squared	0.058741	S.D. dependent var	21271.52
S.E. of regression	20637.31	Akaike info criterion	22.74118
Sum squared resid	4.81E+10	Schwarz criterion	22.83561
Log likelihood	-1326.359	Hannan-Quinn criter.	22.77952
F-statistic	3.413044	Durbin-Watson stat	2.062269
Prob(F-statistic)	0.019936		

Null Hypothesis: D(GOLD_PRICE) has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.900263	0.0000
Test critical values:	1% level	-3.487046	
	5% level	-2.886290	
	10% level	-2.580046	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(GOLD_PRICE,2)
Method: Least Squares
Date: 11/18/22 Time: 13:21
Sample (adjusted): 2011M04 2020M12
Included observations: 117 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.

D(GOLD_PRICE(-1))	-0.912673	0.115524	-7.900263	0.0000
D(GOLD_PRICE(-1),2)	0.162064	0.092277	1.756287	0.0817
C	5038.624	2022.164	2.491699	0.0142

R-squared	0.409578	Mean dependent var	-112.2308
Adjusted R-squared	0.399220	S.D. dependent var	26680.08
S.E. of regression	20679.73	Akaike info criterion	22.73700
Sum squared resid	4.88E+10	Schwarz criterion	22.80783
Log likelihood	-1327.115	Hannan-Quinn criter.	22.76576
F-statistic	39.54115	Durbin-Watson stat	2.043604
Prob(F-statistic)	0.000000		

Null Hypothesis: GOLD_PRICE has a unit root
Exogenous: Constant
Bandwidth: 17 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		1.443955	0.9991
Test critical values:	1% level	-3.486064	
	5% level	-2.885863	
	10% level	-2.579818	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	4.39E+08
HAC corrected variance (Bartlett kernel)	3.47E+08

Phillips-Perron Test Equation
Dependent Variable: D(GOLD_PRICE)
Method: Least Squares
Date: 11/18/22 Time: 13:23
Sample (adjusted): 2011M02 2020M12
Included observations: 119 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
GOLD_PRICE(-1)	0.011662	0.010043	1.161185	0.2479
C	-4279.360	8814.473	-0.485492	0.6282

R-squared	0.011393	Mean dependent var	5705.950
Adjusted R-squared	0.002943	S.D. dependent var	21149.96
S.E. of regression	21118.81	Akaike info criterion	22.77038
Sum squared resid	5.22E+10	Schwarz criterion	22.81709
Log likelihood	-1352.838	Hannan-Quinn criter.	22.78935
F-statistic	1.348350	Durbin-Watson stat	1.601063
Prob(F-statistic)	0.247930		

Null Hypothesis: D(GOLD_PRICE) has a unit root
Exogenous: Constant
Bandwidth: 16 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-8.483247	0.0000
Test critical values:	1% level	-3.486551	
	5% level	-2.886074	

	10% level	-2.579931

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	4.25E+08
HAC corrected variance (Bartlett kernel)	3.32E+08

Phillips-Perron Test Equation
Dependent Variable: D(GOLD_PRICE,2)
Method: Least Squares
Date: 11/18/22 Time: 13:25
Sample (adjusted): 2011M03 2020M12
Included observations: 118 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(GOLD_PRICE(-1))	-0.783539	0.090517	-8.656234	0.0000
C	4367.857	1983.057	2.202587	0.0296

R-squared	0.392449	Mean dependent var	-109.1949
Adjusted R-squared	0.387211	S.D. dependent var	26565.84
S.E. of regression	20795.96	Akaike info criterion	22.73971
Sum squared resid	5.02E+10	Schwarz criterion	22.78667
Log likelihood	-1339.643	Hannan-Quinn criter.	22.75878
F-statistic	74.93039	Durbin-Watson stat	1.932294
Prob(F-statistic)	0.000000		

Null Hypothesis: EXCHANGE_RATE has a unit root
Exogenous: Constant
Lag Length: 1 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-1.173541	0.6842
Test critical values:	1% level	-3.486551	
	5% level	-2.886074	
	10% level	-2.579931	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EXCHANGE_RATE)
Method: Least Squares
Date: 11/18/22 Time: 13:25
Sample (adjusted): 2011M03 2020M12
Included observations: 118 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXCHANGE_RATE(-1)	-0.013782	0.011744	-1.173541	0.2430
D(EXCHANGE_RATE(-1))	0.295789	0.088289	3.350228	0.0011
C	18.81741	14.14739	1.330098	0.1861

R-squared	0.097428	Mean dependent var	3.780508
Adjusted R-squared	0.081731	S.D. dependent var	34.69785
S.E. of regression	33.24968	Akaike info criterion	9.871062
Sum squared resid	127137.2	Schwarz criterion	9.941503
Log likelihood	-579.3927	Hannan-Quinn criter.	9.899663
F-statistic	6.206841	Durbin-Watson stat	2.016442
Prob(F-statistic)	0.002756		

Null Hypothesis: D(EXCHANGE_RATE) has a unit root
Exogenous: Constant
Lag Length: 0 (Automatic - based on SIC, maxlag=12)

		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-7.994790	0.0000
Test critical values:	1% level	-3.486551	
	5% level	-2.886074	
	10% level	-2.579931	

*MacKinnon (1996) one-sided p-values.

Augmented Dickey-Fuller Test Equation
Dependent Variable: D(EXCHANGE_RATE,2)
Method: Least Squares
Date: 11/18/22 Time: 13:26
Sample (adjusted): 2011M03 2020M12
Included observations: 118 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EXCHANGE_RATE(-1))	-0.706783	0.088405	-7.994790	0.0000
C	2.613355	3.085983	0.846847	0.3988

R-squared	0.355257	Mean dependent var	-0.200000
Adjusted R-squared	0.349699	S.D. dependent var	41.29859
S.E. of regression	33.30369	Akaike info criterion	9.866018
Sum squared resid	128659.8	Schwarz criterion	9.912978
Log likelihood	-580.0950	Hannan-Quinn criter.	9.885085
F-statistic	63.91667	Durbin-Watson stat	2.014494
Prob(F-statistic)	0.000000		

Null Hypothesis: EXCHANGE_RATE has a unit root
Exogenous: Constant
Bandwidth: 1 (Newey-West automatic) using Bartlett kernel

	Adj. t-Stat	Prob.*

Phillips-Perron test statistic		-1.199723	0.6731
Test critical values:	1% level	-3.486064	
	5% level	-2.885863	
	10% level	-2.579818	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	1180.041
HAC corrected variance (Bartlett kernel)	1529.065

Phillips-Perron Test Equation
Dependent Variable: D(EXCHANGE_RATE)
Method: Least Squares
Date: 11/18/22 Time: 13:26
Sample (adjusted): 2011M02 2020M12
Included observations: 119 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
EXCHANGE_RATE(-1)	-0.014017	0.012150	-1.153651	0.2510
C	20.52018	14.61025	1.404506	0.1628

R-squared	0.011247	Mean dependent var	4.068067
Adjusted R-squared	0.002796	S.D. dependent var	34.69262
S.E. of regression	34.64408	Akaike info criterion	9.944795
Sum squared resid	140424.8	Schwarz criterion	9.991503
Log likelihood	-589.7153	Hannan-Quinn criter.	9.963761
F-statistic	1.330911	Durbin-Watson stat	1.401252
Prob(F-statistic)	0.250994		

Null Hypothesis: D(EXCHANGE_RATE) has a unit root
Exogenous: Constant
Bandwidth: 2 (Newey-West automatic) using Bartlett kernel

		Adj. t-Stat	Prob.*
Phillips-Perron test statistic		-8.005609	0.0000
Test critical values:	1% level	-3.486551	
	5% level	-2.886074	
	10% level	-2.579931	

*MacKinnon (1996) one-sided p-values.

Residual variance (no correction)	1090.337
HAC corrected variance (Bartlett kernel)	1100.352

Phillips-Perron Test Equation
Dependent Variable: D(EXCHANGE_RATE,2)
Method: Least Squares
Date: 11/18/22 Time: 13:26
Sample (adjusted): 2011M03 2020M12
Included observations: 118 after adjustments

Variable	Coefficient	Std. Error	t-Statistic	Prob.
D(EXCHANGE_RATE(-1))	-0.706783	0.088405	-7.994790	0.0000

C	2.613355	3.085983	0.846847	0.3988

R-squared	0.355257	Mean dependent var	-0.200000
Adjusted R-squared	0.349699	S.D. dependent var	41.29859
S.E. of regression	33.30369	Akaike info criterion	9.866018
Sum squared resid	128659.8	Schwarz criterion	9.912978
Log likelihood	-580.0950	Hannan-Quinn criter.	9.885085
F-statistic	63.91667	Durbin-Watson stat	2.014494
Prob(F-statistic)	0.000000		

Vector Autoregression Estimates
Date: 11/18/22 Time: 13:27
Sample (adjusted): 2011M03 2020M12
Included observations: 118 after adjustments
Standard errors in ( ) & t-statistics in [ ]

	GOLD_PRICE	EXCHANGE_RATE
GOLD_PRICE(-1)	1.182640	-0.000248
	(0.09252)	(0.00015)
	[12.7831]	[-1.68074]
GOLD_PRICE(-2)	-0.189299	0.000245
	(0.09371)	(0.00015)
	[-2.01996]	[1.63704]
EXCHANGE_RATE(-1)	55.44703	1.299853
	(56.4132)	(0.08992)
	[0.98287]	[14.4558]
EXCHANGE_RATE(-2)	-40.56870	-0.308190
	(57.8801)	(0.09226)
	[-0.70091]	[-3.34054]
C	-7428.547	16.60565
	(9476.27)	(15.1046)
	[-0.78391]	[1.09937]
R-squared	0.989231	0.984412
Adj. R-squared	0.988850	0.983861
Sum sq. resids	4.88E+10	124026.1
S.E. equation	20784.75	33.12969
F-statistic	2595.011	1784.090
Log likelihood	-1338.033	-577.9310
Akaike AIC	22.76328	9.880186
Schwarz SC	22.88068	9.997588
Mean dependent	863692.0	1180.303
S.D. dependent	196835.1	260.7800

Determinant resid covariance (dof adj.)	4.66E+11
Determinant resid covariance	4.27E+11
Log likelihood	-1914.944
Akaike information criterion	32.62618
Schwarz criterion	32.86098
Number of coefficients	10

VAR Lag Order Selection Criteria

Endogenous variables: GOLD_PRICE EXCHANGE_RATE
Exogenous variables: C
Date: 11/18/22 Time: 13:28
Sample: 2011M01 2020M12
Included observations: 112

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-2255.190	NA	1.10e+15	40.30696	40.35550	40.32665
1	-1820.307	846.4673	5.00e+11	32.61263	32.75826*	32.67172
2	-1811.323	17.16618*	4.57e+11*	32.52363*	32.76635	32.62211*
3	-1807.765	6.672224	4.61e+11	32.53151	32.87132	32.66938
4	-1805.956	3.326199	4.79e+11	32.57065	33.00755	32.74791
5	-1801.313	8.375052	4.74e+11	32.55915	33.09314	32.77581
6	-1798.924	4.222469	4.88e+11	32.58793	33.21901	32.84398
7	-1797.859	1.844671	5.15e+11	32.64034	33.36851	32.93578
8	-1795.336	4.281099	5.30e+11	32.66671	33.49196	33.00154

* indicates lag order selected by the criterion
LR: sequential modified LR test statistic (each test at 5% level)
FPE: Final prediction error
AIC: Akaike information criterion
SC: Schwarz information criterion
HQ: Hannan-Quinn information criterion

Date: 11/18/22 Time: 13:30
Sample (adjusted): 2011M03 2020M12
Included observations: 118 after adjustments
Trend assumption: Linear deterministic trend
Series: GOLD_PRICE EXCHANGE_RATE
Lags interval (in first differences): 1 to 1

Unrestricted Cointegration Rank Test (Trace)

Hypothesized No. of CE(s)	Eigenvalue	Trace Statistic	0.05 Critical Value	Prob.**
None	0.029530	3.624793	15.49471	0.9315
At most 1	0.000744	0.087799	3.841466	0.7670

Trace test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)

Hypothesized No. of CE(s)	Eigenvalue	Max-Eigen Statistic	0.05 Critical Value	Prob.**
None	0.029530	3.536993	14.26460	0.9047
At most 1	0.000744	0.087799	3.841466	0.7670

Max-eigenvalue test indicates no cointegration at the 0.05 level
* denotes rejection of the hypothesis at the 0.05 level
**MacKinnon-Haug-Michelis (1999) p-values

Unrestricted Cointegrating Coefficients (normalized by b'*S11*b=I):

GOLD_PRICE	EXCHANGE_RATE

-1.36E-06	0.004618
8.53E-06	-0.004182

Unrestricted Adjustment Coefficients (alpha):

D(GOLD_PRICE)	2940.954	-310.4119
D(EXCHANGE_RATE)	-2.522600	-0.791635

1 Cointegrating Equation(s): Log likelihood -1914.988

Normalized cointegrating coefficients (standard error in parentheses)

GOLD_PRICE	EXCHANGE_RATE
1.000000	-3386.070
	(1535.45)

Adjustment coefficients (standard error in parentheses)

D(GOLD_PRICE)	-0.004011
	(0.00260)
D(EXCHANGE_RATE)	3.44E-06
	(4.1E-06)

Pairwise Granger Causality Tests
Date: 11/18/22 Time: 13:31
Sample: 2011M01 2020M12
Lags: 2

Null Hypothesis:	Obs	F-Statistic	Prob.
D(GOLD_PRICE) does not Granger Cause D(EXCHANGE_RATE)	117	2.88489	0.0600
D(EXCHANGE_RATE) does not Granger Cause D(GOLD_PRICE)		0.17442	0.8402